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Exploring the Musical Mind

Exploring the
MUSICAL

Jacob Kwalwasser

COLEMAN-ROSS COMPANY, INC.
New York

MIND

Professor Emeritus, Syracuse University

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To my children
Edgar, Robert, Helen
and my wife Pearl

4.50

Preface

NOT EVERYONE, obviously, has the required equipment to become a musician. To achieve success, indispensable requirements in motor, sensory, emotional, intellectual, and esthetic capacities are needed. Between the categories of "good" and "poor" musically, vast measurable innate differences are found. No matter how expert the teaching, talent cannot be bestowed upon the learner. Sterling instruction, favorable environment, industry, interest, and intensity of drive are all valuable assets as far as they go, but they are not substitutes for talent.

As Research Professor at Syracuse University, the author conducted and supervised scores of studies leading to the master's and doctor's degrees. Over a period of more than twenty-five years, large populations in college, high school, and grade school were measured and studied. Employing standardized tests, such areas as auditory discrimination and acuity, motor responses, music talent, music achievement, and general intelligence were thoroughly explored. Measurements showing the influence of age, grade classification, sex, training, intelligence, nationality, etc., are now available.

The key studies based upon mass measurement will be reviewed in the following pages and the results should be thought-provoking, for this material, interpreted objectively, casts many doubts on the efficacy of some of our cherished pedagogical practices. The twofold purpose in writing this book is to *disseminate* the results of organized experimentation and to *interpret* these results in terms of a more progressive pedagogy. Where radical changes are indicated, the author will press for substantial reforms.

J. K.

New York City, 1955

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"Let us measure our ambition by our talents, and let not our desires outstrip our ability to fulfill these desires. Since we cannot attain what we wish, let us wish only what we can attain."

Leonardo da Vinci: *Codex*

1

Music Talent and Inheritance

MUSIC HISTORY is replete with biographical records of musical families, great and near-great, past and present, that dramatize the role of musical inheritance. Geiringer's [45]* text on the Bach family traces their contributions to music from 1604 to 1845; from Johann Sebastian Bach's great-uncle to William Ernst Bach, his grandson, during which time twelve Bachs distinguished themselves for musical achievement. Wiggam [185] places the number of famous musicians in the Bach family at twenty-five and adds thirteen others as being highly talented. The Weber family also produced many distinguished musicians for a number of consecutive generations, the most gifted being Carl Maria von Weber. To the music educator who relegates musical inheritance to the distant past, the following paragraphs should be most revealing, for musical families are in greater supply now than ever before in history.

Going back a few generations we learn that Johannes Brahms was the son of Johann Jacob Brahms, a double-bass player, who was forced to run away from home to devote himself seriously to music. Vincenzo Bellini, son of an organist, received his first lessons from his father. Cherubini was taught by his father. Max Bruch came from a well-known and gifted musical family of the Lower Rhine. Edvard Grieg received his early musical instruction from his mother. Jean Viotti, founder of the modern school of violin playing, was taught the elements of music by his father. Franz Liszt was instructed by his father. Wolfgang Amadeus Mozart's father was a fine violinist, and his sister an accomplished pianist with whom he toured Europe. His mother was both a vocalist and pianist. Niccolo Paganini was taught by his father. Richard Strauss's father was a French Horn player and professor at the Royal Academy of Music in Munich.

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* See corresponding number in the Bibliography of Works Cited, pages 167–181.

Ignoring the order of lineage, the following list is impressive. Leopold Damrosch, the father of Walter and Frank, was a composer, conductor, and violinist. Both parents of Antal Dorati were accomplished musicians. Pablo Casals's father was a composer and organist. John Alden Carpenter's mother was a singer. Claudio Arrau's mother and grandmother were musicians. Wanda Landowska's father was a musician. Daniel Gregory Mason's father and grandfather were musicians of note. Gian-Carlo Menotti's mother was his early tutor. The father of Charles Munch was church organist and founder of the St. Guillaume Choir in Strasbourg. His brother Fritz is also a musician. Gregor Piatigorsky's father was a violinist. Fritz Reiner's mother was a pianist. Carlos Salzedo's father was a professor of voice at the Paris Conservatory. Joseph Szigeti was taught by his father. Helen Traubel was taught by her mother, a professional singer. Efrem Zimbalist's father was the conductor of the Rostov Opera Company Orchestra. Fritz Kreisler received early instruction from his father, as did Jascha Heifetz. Alexander Brailowsky was taught by his father. Paul Whiteman's father was a music educator. Ernst von Dohnanyi's father was a composer. Charles Ives's father was a bandmaster.

Erica Morini's father was a violinist and director of a conservatory in Vienna. Serge Koussevitzky's father was a violinist. Sergei Prokofiev's mother was a pianist. William Primrose's father was a violinist in the London Symphony Orchestra. Tossy Spivakovsky's father was a professional pianist. Igor Stravinsky's father was a basso with the St. Petersburg Imperial Opera; his son Soulima is a concert pianist. Robert Casadesus and his son Jean are concert pianists. Kirsten Flagstad's father was a violinist and conductor; her mother was a pianist and operatic coach; Ole, her brother, is a conductor. Zino Francescatti's father was a violinist. Arthur Fiedler's father and grandfather were musicians. Percy Grainger's mother was a piano teacher. George Rabin and his son Michael, both violinists; Louis Persinger and his son Rolph, violinist and violist. Franz Kneisel and son Frank Jr.; Leopold Mannes and son David; Vladimir Horowitz and his mother; Vladimir and Boris Golschmann; Ernest Bloch and daughter Suzanne; Vladimir Graffman and son Gary; Jan Kubelik and son Rafael; Pierre Monteux and son Claude; Alexander Siloti and daughter Kyriena; Feodor Chaliapin and daughter; etc.

The list of famous siblings in music is also impressive. Pablo Casals's brother Enrique is a violinist. Alfred Cortot has two sisters who teach the piano. The Iturbis, José and sister Amparo; Gaston and Edouard Déthier, organist and violinist; Yehudi and Hephzibah Menuhin, violinist and pianist; Joseph and Lillian Fuchs, violinist and violist; Harold Bauer and sisters, all pianists; Robert Scholz, conductor, and his brother Heinz, pianist; the Galimir Quartet, three sisters and brother Felix, all string players; Ricardo and Nelida Odnoposoff, violinist and pianist; Lotte Lehmann and her brother Fritz; Estelle Liebling and brothers Leonard and James; Carol Brice and brother Eugene, vocalist and pianist; Ruggiero and George Ricci, violinist and cellist; Vittorio, composer, and Dusolina Giannini, opera singer; Isidor and Joseph Achron; Fritz, Herman, and Adolph Busch; Bess and Alan Lomax; the Gombergs; the Fishbergs, and many others.

It is evident that music making as a profession may engage the attention of more than one member of a family and may be extended in time over two or more generations. While the distinguished members of musical families cited in the preceding paragraphs, and countless others omitted for lack of space, show marked talent — supporting the theory of inherited musical structures — tremendous variations in talent are found within the family both quantitatively and qualitatively.

There is, virtually, an unlimited number of musical families engaged in music making on all levels of performance from virtuoso to amateur. It is evident from the study of musical families that musical inheritance plays a conspicuous role, yet it remains quite unexplored scientifically. We know that the development of an individual is dependent upon the interaction of two sets of factors — heredity and environment. Galton [38] named these values "nature" and "nurture." We have been taught that man is the product of his environment, but studies in genetics tend to emphasize the more commanding position of heredity. Nevertheless, educators in general, and music educators in particular, assign greater importance to nurture. Obviously, the resolution of the nature-nurture dichotomy is based on expediency rather than on experimentation.

Employing the questionnaire method in a study of musical heritage, Amram Scheinfeld [149] inquired into the careers of 122 musicians, representing three groups:

1. Thirty-six outstanding instrumental musicians of world renown — those universally conceded to be leading figures in our present-day concert halls.
2. Thirty-six principals of the Metropolitan Opera Company (season 1937–38) concededly representing a large

proportion of the best known and most talented singers.

3. Fifty students of the Juilliard Graduate School of Music comprising a highly selective group of younger musicians and singers, many of whom were already active in the professional field.

Direct questions were answered by each artist individually, with only two exceptions: Arturo Toscanini, for whom data was supplied by one close to him officially; and Yehudi Menuhin, in which case the data came from his father. The result is a rather imposing array of facts, subsequently analyzed and presented.

In the first group are such artists as Eugene Ormandy, Gregor Piatigorsky, Sergei Prokofiev, Sergei Rachmaninoff, Artur Rodzinski, Moritz Rosenthal, Artur Rubinstein, Artur Schnabel, Toscha Seidel, Rudolf Serkin, Ruth Slenczynski, Jan Smeterlin, Joseph Szigeti, Arturo Toscanini, Alfred Wallenstein, Efrem Zimbalist, and others. A total of 36 instrumentalists and conductors were studied. The answers show:

1. The average age at which talent was expressed was $4\frac{3}{4}$ years.
2. The average age of professional debut was $13\frac{1}{4}$ years.
3. A total of 17 mothers were talented.
4. A total of 29 fathers were talented.
5. Out of a total of 155 brothers and sisters, 55 were talented.

In the second group of thirty-six Metropolitan Opera vocalists are such artists as Rose Bampton, Lucrezia Bori, Karin Branzell, Hilda Burke, Gina Gigna, Susanne Fisher, Kirsten Flagstad, Dusolina Giannini, Helen Jepson, Marjorie Lawrence, Lotte Lehmann, Queena Mario, Lily Pons, Rosa Ponselle, Grace Moore, Gladys Swarthout, Richard Bonelli, Charles Kullman, Richard Crooks, Lauritz Melchior, Ezio Pinza, John Charles Thomas, Lawrence Tibbett, and others. The men vocalists reported:

1. The average age at which talent was expressed was 11 years 5 months.
2. The average age of professional debut was 17 years 7 months.
3. A total of 9 mothers were talented.
4. A total of 11 fathers were talented.
5. Out of 59 brothers and sisters, 18 were talented.

The women vocalists reported:

1. The average age at which talent was expressed was $8\frac{1}{3}$ years.
2. The average age of professional debut was 15 years 7 months.
3. A total of 14 mothers were talented.
4. A total of 13 fathers were talented.
5. Out of a total of 44 brothers and sisters, 25 were talented.

The fifty vocalists and instrumentalists of the Juilliard Graduate School of Music responded as follows:

1. The average age at which talent was expressed was $5\frac{3}{4}$ years.
2. The average age of professional debut was not available for this group.
3. A total of 37 mothers were talented.
4. A total of 29 fathers were talented.
5. Out of a total of 72 brothers and sisters, 51 were talented.

In summarizing the results of his study, Scheinfeld reports that in the case of brothers and sisters of instrumental virtuosi, 71% were talented in the families in which both parents were talented; 60% where one parent was talented; and only 15% where neither parent was talented.

With but slight variation, these percentages hold for the other two groups. Where both parents are talented, one-half to three-fourths of the children are talented. Where only one parent is talented one-half of the children are talented. Where neither parent is talented the average of talented offspring is one-fourth or less.

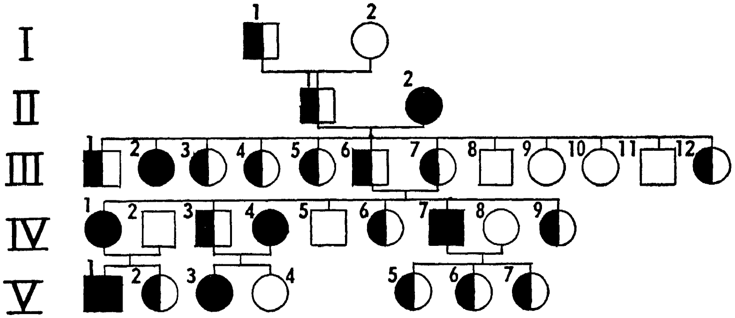
However, Scheinfeld does not ignore the problem of environment, for he examined the backgrounds of all of the musicians participating in his study and found no uniform environmental influence. True enough, the backgrounds of many of the musicians and singers were highly favorable to talent development, but he also found individuals like Toscanini, Rubinstein, Seidel, Smeterlin, Schnabel, Iturbi, Grace Moore, Gladys Swarthout, Martinelli, and others emerging from homes where neither parent was musical. In some cases the background might have been considered almost deadening for musical expression. "The possibility that something unusual in the environment can produce these early manifestations becomes more remote when we see that a home can be as musical as possible and yet no talent may appear, or it may appear in one child and not in another. It would seem then that one is or is not born with great musical capacity. Musical talent is in all probability inherited through a number of genes acting together, and without the required number of genes there can be no musical talent." Some studies by German scientists employing the questionnaire method have yielded comparable results. The reader may wish to consult the bibliography for titles and sources of such studies as Haecker and Ziehn,[56] Koch and Mjöen,[77] and Oswald Feis.[34]

O'Connor [121] makes the generalization that genius possesses no more of any one aptitude than one-fourth or three-fourths, depending on whether the trait happens to be recessive or dominant. The reader will recognize this division as Mendelian, originally associated with the laws of inheritance linked with the study of culinary-pea plants. Some tall plants grew taller in rich soil and favorable exposure, while others grew short in rocky soil and unfavorable exposure, but these still possessed the inherent trait of tallness. Dwarf peas revealed comparable traits. Six other pairs of botanically discernible features were studied and charted. Basing his position on Mendelian law, O'Connor contends that a Caruso or a Jenny Lind may score no higher on a specific musical trait than thousands of others might do today, for genius, he maintains, depends more upon a rare combination of several traits than upon the possession of more of any one trait.

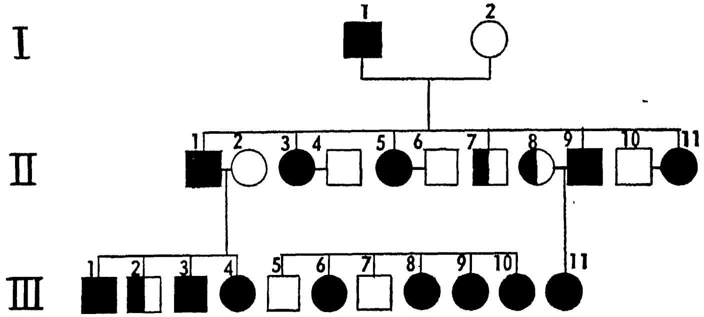
With convincing logic he shows that a single completely isolated recessive trait, in the simplest Mendelian sense, occurs theoretically once in four persons. A specific combination of two such recessive characteristics occurs once among 16 persons. A combination of three occurs once among 64. Pursuing the same mathematics, a combination of 13 recessive characteristics should occur once in some 67,000,000 cases. Dominant traits occur more frequently. A single dominant characteristic is possessed, theoretically, by three persons in every four; a specific combination of two, nine times in 16 cases. A combination of 13 dominant and recessive traits should occur in about 8,000 persons. Assuming that an artist possessed 27 dominant and recessive traits, the mathematical possibility of duplicating the combinations appears to be but once in a population of 130,000,000 persons.

The pedigree chart is more easily comprehended. It is based upon a more superficial treatment of data obtained from questions and answers and supported by some biographical record. We must realize that the criteria used in establishing the three categories may not be as reliable as we desire; yet they reveal the persistence of music-making through a number of generations with graphic clearness. Examine the Reser [138] and Northrup [118] charts for support of the inheritance of musicality.

PEDIGREE CHART
(Reser)



PEDIGREE CHART
(Northrup)



Male ☐ Untalented ■ Highly Talented ◧ Musically Inclined

Female ○ Untalented ● Highly Talented ◐ Musically Inclined

The inadequacy of pedigree studies must be apparent to all. They were introduced to point up a number of critical weaknesses. Only a few concern us at this point and they center around the subject of definition. What criteria were used to establish a category of "highly talented"? How, specifically, do the "musically inclined" differ from the "untalented"? What yardsticks were used for measurement? Is the assumption valid, that only those who achieve musical distinction in a family are musical? These are not rhetorical questions. They strike at the heart of our problem, for whenever and wherever we find achievement we count it as evidence of capacity. Unfortunately for the individual and society, many who possess musical capacity achieve nothing, because they were undiscovered and, therefore, musically undisciplined. More than a generation ago, Seashore[153] pressed this point of view in support of music testing. He urged the testing of young children before they received any music instruction, suspecting that many receiving training were untalented. He insisted that tests could be used as a "dragnet" for the discovery of talent.

Intelligence testing has taught that the genius who achieves highest eminence is one whose intelligence would have been identified early as superior in childhood. The converse of this relationship, however, may not be true, for we may not conclude that every child who tests high in intelligence will achieve eminence. Likewise, it may be stated that there can be no achievement in music without talent, yet there may be talent without achievement. The author bases his support of Seashore's stand on the tens of thousands of children measured with the Seashore and the Kwalwasser-Dykema Music Tests * over a period of more than twenty-five years. There are millions with

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* Kwalwasser-Dykema Music Tests are distributed by Carl Fischer, Inc., New York City.

generous musical potential, who unknowingly waste their resources. There are millions, young and old, with meager and inadequate potential who discontinue the study of music after a brief encounter, which yields practically nothing. As long as we rate music talent in terms of music achievement, we will exclude those who have the equipment to succeed, but for one reason or another are lost to music. The "not talented" category of our pedigree studies probably contains some untrained individuals with ample talent.

Only in the past decade or two have we been able to attack the problem of musicianship, psychometrically. Thanks to aptitude testing, we can isolate specific factors that constitute and condition musicianship. It must be remembered that only a little more than twenty-five years ago scientific music testing was but a theory in the minds of a few men. Today many valuable tests have been devised which measure auditory acuity, discrimination, memory, rhythm, etc. From the field of experimental psychology the music psychologist has access to motor and emotional tests and techniques. The newest branch of applied psychology is music psychology. Music pedagogy, esthetics, and performance will profit from the development of the young science. As it grows, more and better instruments of measurement are in prospect. However, monumental work in music research has been and is being done with the aid of instruments now available. In this mass of experimental material we will find that musical inheritance has not been entirely neglected.

In the early stages of intelligence testing, a number of studies were undertaken in which the intelligence of siblings (brothers and sisters) were compared. These early studies employed statistical techniques to show the amount of correlation between scores earned by members of a family when tested by the same instrument of measurement. An investigation by Davis,[27] conducted in an orphanage, reports no correlation between unrelated children chosen at random, but when brothers and sisters were paired and their scores of intelligence correlated, a fair-sized coefficient +.51 was found. The studies of Gordon [52] based on intelligence scores earned by children in public schools and orphanages, are in marked agreement with those of Davis. Unrelated children, paired by chance, failed to correlate their scores much above zero, while blood relatives, when paired by age and sex, yielded a sizeable correlation of +.66. Following the same design of experimentation, Hildreth [62] studied 450 pairs of siblings in intelligence and achievement with similar results, obtaining correlations of +.63 and +.64 for siblings from 300 families.

The studies measuring siblings in music talent parallel those just presented. Swift [172] gave the Kwalwasser-Dykema Music Tests to all the children in the Hamilton Central and the Ilion Public Schools located in central New York. He had 255 pairs of siblings for whom he correlated scores. Brothers' scores produced a little higher correlation than did sisters' scores (+.56 and +.46), but since only 71 pairs of brothers and 65 pairs of sisters were measured, it would be unwise, until more evidence is collected, to conclude that correlations are higher for brothers than for sisters. The correlation for all brothers and sisters, unmatched for sex, was quite similar to that reported for intelligence, +.48. To check the validity of the results, we picked 100 pairs of scores at random from all the test papers turned in by children of both schools. The correlation for the 200 scores chosen and grouped by chance proved to be both insignificant and unreliable statistically.

One of the rarest studies measuring music talent of twins was undertaken by Mizer.[107] It was based upon the test scores of 25 sets of twins found in the schools of Utica, Brookfield, Madison, Sherrill, and Whitesboro, all of central New York. As might be expected, the correlation coefficient earned by twins was found to be much higher than that earned by siblings on the Kwalwasser-Dykema Music Tests, namely, +.77, and +.84 on the Kwalwasser-Ruch Music Accomplishment Test * — a test that measures knowledge of musical symbols employed in music notation. With higher correlations it is possible to predict, with qualifications, what one twin will earn on these tests from what the other has earned, without testing the other. Prediction is the purpose of correlation and as the coefficient increases, the error in the prediction decreases.

In a recent study 315 Negro children, representing 151 families in the Williston Industrial High School of Williston, North Carolina, were measured in both intelligence and musicianship by Williams.[186] Her correlations for 151 siblings for the Otis Intelligence Test were +.57 and +.53 for the same children on the Kwalwasser-Dykema Music Tests, but when random pairings were made in which blood relationship was ignored, the correlations approached zero. While the author realizes the magnitude of error in predicting musicianship or intelligence of one sibling when another is measured, it is gratifying to observe that our predictions are as accurate for music as they are for intelligence.

For many years it has been the author's desire to make a more direct attack on the problem of musical inheritance, in which at least two generations would submit to measurement so that we might compare parents and their offspring. The design of such a research project is simple enough and no difficulty was anticipated. Three very successful music supervisors,[120, 151, 161] popular with students

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* Kwalwasser-Ruch Musical Accomplishment Test, published by Extension Division, State University of Iowa, Iowa City, Iowa.

and parents, launched the study. Each hoped to measure 200 families having at least two school-age children. Measuring the school children presented no problem, but the same could not be said of the parents. Many of the mothers were interested in the project but experienced difficulty in arranging the time for testing, while most of the fathers appeared to be rather disinterested and uncooperative. The researchers were compelled to go to neighboring towns to get additional data and were ultimately obliged to conclude their investigation with a greatly reduced number of parents tested. The correlation between parents and offspring was found to be lower than that earned by siblings, which may be due to (1) the unfavorable attitude of the parents, which may in part explain their inferior showing; (2) the age differential, when considerable, tends to drop correlations; (3) the deterioration in hearing which may be linked to the age of the parents. Since statistical study of parent and progeny scores promises help in predicting the music talent of progeny from that of parents, or vice versa, we hope that such information may become available since it would be of value to music education.

We do know from biological research that gifted parents are more likely to produce gifted children and that inferior parents are more likely to produce inferior children. However, no parent has a sure thing in his children either for good or ill. Every child starts with a combination of congenital qualities that no one else has — so we are told. An enlightened system of education must not suppress the individual nor ignore native equipment in an attempt to make children alike. Regimentation of this sort must be rejected if our democracy is to live and thrive. Our statistical studies show that prediction of similarity increases with accuracy when twins are compared musically; even greater resemblances are found when twins are identical, but resemblances diminish a little with the measurements of brothers and sisters and, finally, are practically non-existent in the scores of unrelated children. Accuracy in prediction is greater between parent and offspring than for random pairings of unrelated children, and less than that computed for siblings. Except for family considerations we must conclude that individuals are diverse in their underlying musical potentialities. Rightly understood, democracy guarantees the individual freedom to develop his unique capabilities. Nature has made us different and that difference must be recognized in education and used for the good of the individual and society.

2

Race and Nationality

NATIONS AND RACES are both homogeneous and heterogeneous. This axiom is an unfailing source of interest to students of psychology, sociology, and anthropology; in fact, to all branches of social science. Physical, mental, emotional, and social differences of tremendous magnitude are found within groups, regardless of the nature of the traits measured. When experimenters show that there is greater difference *within* groups than *between* groups, they are not denying the heterogeneous make-up of large populations. They are dealing with the homogeneous nature of man, by comparing the average achievements of groups. That the difference in average accomplishment between groups is less than the difference in individual accomplishment within a group is to be expected. In the preceding chapter we presented statistical evidence of the homogeneous nature of the family group. When blood relationship was not used as a basis of grouping, scores were more heterogeneous. It would be indefensible to accept one and reject the other, merely to simplify our thinking. The two values, being actually co-existent, are not in conflict but complement each other.

When we realize that approximately one-third of our school population is made up of persons who are foreign-born or the children of foreign-born parents, we understand why the study of national and racial traits is important, educationally. School administrators are eager to learn more about the differences between boys and girls of foreign parentage as contrasted with native American stock. In our cosmopolitan areas, where language may be only one of many encumbrances to education, the problem of meeting racial and national differences ceases to be merely academic.

With the standardization of intelligence testing, many investigations were launched. A pioneer comparative study of American and foreign children was made in one of New York City's schools by Pintner [130] employing the National Intelligence Test and a non-language test bearing his name. He found considerable difference between the native and foreign groups on the intelligence test but very little on the non-verbal test. Only 37% of the foreign-born reached the median of the native group. However, he tries to minimize the differences, maintaining that they are the product of language difficulties that beset the foreign child. From the results of many other studies by Pintner, Keller, Sheldon, and others, Goodenough [50] theorizes as follows: (1) that the racial showing of southern Europeans and Negroes with their lower intelligence scores is due to postnatal factors such as inferior environment, poor physical condition, and language handicaps; (2) while accepting the influence of these conditions as they lower test scores, innate differences in mentality among the groups under consideration account almost entirely for the differences obtained. Goodenough devised an intelligence test which required no language use, merely the drawing of human figures. From the first through the fourth grades she tested 2,457 children. The scores on this unique method of intelligence measurement correspond closely to the order in which verbal tests placed the children.

In a period of a few years, the immigrant child acquires sufficient command of the English language so that it no longer jeopardizes his intelligence score, for he tests as high, using English as he does with his native tongue. This conclusion is considered crucial by Brown,[15] since language handicaps last only for a short period of time. The rating of a large number of children of foreign parentage from different parts of the country based upon the scores earned on the Stanford-Binet Test of Intelligence was determined by Bere.[10] She grouped her subjects into four large divisions. The order in descending rank was mathematically computed on the basis of the average quotient of intelligence earned by each division, and was found to favor the north Europeans. The Orientals followed, the east and central Europeans were third in mental standing, and at the bottom were the south Europeans. These results are quite similar to those for adults of different nations issued by United States Army psychologists.

These results not only stratified north, central, and south Europeans on mental layers but it also split the psychological fraternity into two camps: one insisted that innate differences were being measured, while the other attributed the differences to culture and mode of life. For example, Thorndike,[177] commenting on the subject, accepted the great differences found in the so-called higher traits, such as the capacity to analyze, associate, and to think creatively. Woodworth [189] believed in discounting somewhat the results in favor of primitive peoples tested. While both men employed and promoted the use of mental measurement, they were not in agreement on the interpretation of the results obtained from measurement.

Probably no group has been subjected to more study than the Negro, but we will limit our review to only a few investigations dealing with his intellect first and then his musicianship. While it is evident that, with some reservations, the Negro is inferior to the white child of comparable age in intelligence, he is generally found to be inferior in most music talent traits, with the exception of rhythm and tonal memory in which he frequently surpasses the whites. Returning to our investigations we learn from Strong,[169] who measured 129 white and Negro children of comparable grades, that the whites were superior whether measured by teachers' marks or mental tests, or by distribution in age through the grades. The Negro children made relatively slow progress in school.

Mayo [101] studied 300 Negro and white children in New York City. The median age for the white children on entering high school was 14 years 6 months; for the Negro children, 15 years 1 month. The white group was more homogeneous in age and only 27% of the whites were as old as the median for Negro children. The Negro children remain in school longer than the whites; the average for the Negroes attending high school being 4.5 terms, compared with 3.8 terms for the whites. About 28% of the whites complete their high school training in 4.5 terms and 29% of the Negro children complete their high school training in 3.8 terms. The Negro children passed 58% of the courses in high school (2,382) while 76% of the courses (2,433) were passed by the whites. From all of the data which he collected, he generalizes that the efficiency of the Negroes is only 78% of that of the whites.

We know that the Negroes achieve maturity earlier than do the whites and scores on mental tests show the influence of earlier adolescence. For the chronological ages of 10, 11, and 12 the Negroes approach but fail to equal the average scores of the whites of comparable age, but on younger and older age levels they fall far behind the whites. The reader may be familiar with a theory of adolescence which links early maturation with inferior status of the adult. The Italians of Pintner's research and the Negroes in Morse's [110] study earned inferior scores on the Stanford-Binet tests, and both groups mature anywhere from a year to three before native whites. The relationship between later adolescence and greater mental stature is challenging.

Another theory, which attempts to interpret the lower scores of the Negroes confronted by a testing situation, maintains that they are more inexperienced in the techniques of taking tests. Furthermore, it is claimed, they have misgivings concerning their educational status and become apprehensive. Therefore, they cannot do their best. By way of contrast, the Jews thrive on testing pressure, so it is claimed. Both statements are bits of rationalization with which the author has little sympathy.

The Lenoire [94] study, now to be reported, reveals that "the Negro is far superior to the white child in rhythm and tonal memory and not inferior in any of the other sensory capacities measured by the Seashore Tests." It was the author's privilege to assist Lenoire in the supervision of this pioneer study of Negro music talent, and though more than twenty-five years have elapsed, no one has yet mentioned the anxiety factor of the white child as the reason for his inferior showing. Lenoire conducted his experiment in the fifth grades of the Gary, Indiana, public schools. He compared the scores of 200 Negro fifth graders with those of 200 white fifth graders. The percentiles for the two groups on rhythm show that the Negroes earned a median of 66, and the whites 61.5. Subsequent studies have yielded both confirming and conflicting evidence of the Negroes' superiority in rhythm and many of the other measurable traits identified with music talent.

Extending the educational range through college, Johnson [72] measured 3,350 Negroes in North Carolina, South Carolina, and Virginia with the Seashore Measures of Musical Talent. He could find no conclusive evidence of either inferiority or superiority on the part of the Negroes. Basing his comparisons on the printed manual issued by

Seashore, he found the college median for rhythm earned by Negroes to be equal to the norm for whites, but for the remaining tests the Negro college student falls from 1 to 6 points below the norm. The Negro eighth-grade median exceeds the white norm in rhythm, but for the rest, the medians are several points under the white level. In the fifth grade, the Negroes equal or exceed the norm in four of the five tests by a few points. Of the three levels, the Negroes made their best showing in rhythm for all levels, and excelled on the fifth-grade level. Johnson refrains from making far-reaching generalizations, stating that they are not justified statistically.

When 300 white students from Peabody Conservatory of Music and 274 Negro students from Fiske University were tested in pitch and consonance, the Negroes were found to be superior in both by a very substantial margin. Making a further study in which 386 white students from the Middle Tennessee State Teachers College at Murfreesboro and 296 Negro students from the Agricultural and Industrial Normal College at Nashville were compared, Peterson and Lanier [129] obtained higher scores for whites on all Seashore tests with the single exception of rhythm. Negroes and mulattoes numbering 258 and whites numbering 219 were tested in the seventh and eighth grades of South Beaumont and Port Arthur, Texas. Both the Seashore tests and the Stanford Achievement tests were used. The whites were considerably better in most measurements, while the Negroes were slightly superior in consonance. The least difference appeared in intensity and time. The mental age of the Negroes was lower by three years while their chronological age differed by only a few months.[54]

Employing the Kwalwasser-Dykema tests, Streep [168] measured 1,315 children in the New York City Schools, 637 whites and 678 Negroes in grades three, four, five, and six. The Negroes earned higher scores than the whites in rhythm and consonance. In an unpublished study of 752 Negro pupils in a midwestern town, Robinson and Holmes,[140] using the same test, found the whites to be superior. With the exception of rhythm, in which the whites still excelled but only slightly, the superiority of the whites was marked. Using the same tests, Mooney [109] measured 258 white native children, 123 of Italian-born parentage and 59 Negro sixth graders in the Montclair Public Schools, New Jersey. The children of Italian immigrants earned the lowest scores; the native whites earned the highest scores and the Negroes were between the two other groups. In intelligence, the Kuhlmann-Anderson tests distributed the three groups in precisely the same order as the Kwalwasser-Dykema Tests. The native whites earned an average score of 103.7; Negroes 97.9; and Italians 97.2.

The results of studies that have been reviewed to this point show some agreement, even when different instruments of measurements and different populations are involved. There can be little controversy over the decision of white superiority in intelligence based on standardized test scores of whites and Negroes. In the area of music talent measurement, the superior scores are not so widely separated, nor so consistently linked with white groups. When the Negroes excel, it is usually in rhythm scores and less frequently in consonance and memory, but they do not always have a clear-cut superiority in rhythm that can be predicted with certainty. Of course we can defend the statement that the Negro is superior in rhythm, by which we mean, his achievement in rhythm is greater than that earned on any other music talent test. However, when we compare the Negroes and the whites in rhythm and assign the Negro a position of superiority over the whites, we may be right or wrong, depending on chronological age, and sampling variations which are beyond the control of the investigator. While the Negro scores relatively higher in music talent than he does in intelligence tests, he is inferior in both, when we take the trouble to compare earned averages of large school populations.

Continuing with inventories of music talent as measured by music tests, we wish to present information on Mexican, Japanese, Eskimo, and Indian children before proceeding to larger studies of European children tested both here and abroad. To 746 seventh-, eighth-, and ninth-grade children, six Seashore tests were given. Garth and Candor [41] found the Mexican children inferior in pitch and rhythm. A total of 337 Japanese children in Los Angeles public schools were tested by Ross [142] and their scores compared with those earned by approximately 550 Indian children, representing many different tribes and distributed through most of the western states, boarding school pupils of the United States Government Indian School System. The Indian children enter school at the fourth grade level. These tests were the first in which they had participated. Only in the sense of time were the Indians superior. The Japanese were superior in both consonance and time, as indicated by the norm. Another Indian study by Garth and Isbell [42] measuring 769 children in Indian schools at Chilocco, Oklahoma, Rapid City, South Dakota, Santa Fe and Albuquerque, New Mexico produced similar results. They earned higher scores in time and rhythm, were slightly deficient in consonance, and weak to a marked degree in pitch, intensity, and memory. The superiority of the Indian in the sense of time seems to be consistent and strong. A study by Eells [31] measuring 162 Indians in Alaska along with 286 Eskimos and 103 Aleuts, with the aid of the Seashore tests of pitch, intensity, and memory, found all three groups definitely inferior on every test for every grade-level. Unfortunately, the sense of time was not measured. Nevertheless, four Eskimos and one Aleut earned scores higher than 99% of the whites.

The author supervised a music talent study in which 123 Alaskan Indians, representing the tribes of Thlinget, Tinneh, Haida, and Tsimpseh, were tested with the Kwalwasser-Dykema Music Tests. Subsequently, 145 children in Oneida Public Schools were also tested and the two populations compared. "Music seems to mean more to the native Alaskan children than it does to our children in the States," wrote Beam.[6] "Life is so harsh and severe and it is through music that the children found a means of escape, taking such delight in music making." All children spoke and understood English. In both groups, the girls earned higher scores than the boys. The Alaskan children were superior in quality, intensity, time, pitch, and taste. The two groups were not equated as to age; the Alaskans were 1.3 years older than the children from Oneida; practically the same in height and 10.1 pounds heavier. In total score the advantage was earned by the Alaskan children with a score of 192.3 against 190.2.

Sward's[171] study of 200 Jewish ten-, eleven-, and twelve-year-olds in music talent and 300 Jewish adults in musical achievement is one of many in this category. He employed the Seashore, Kwalwasser-Dykema, and the Drake Musical Memory tests to measure the children and found the Jewish children "slightly superior" to the non-Jewish children. About adult Jews he writes: "From data available, it is apparent that Jewish incidence among American musicians exceeds expectancy. About 50% of the violin virtuosi and maestros and violinists in American symphony orchestras are of Jewish origin. One-quarter to one-half of the piano virtuosi and symphonic and amusement instrumentalists are Jewish. Ten percent of American composers are of Jewish extraction." In spite of the fact that he validates the testing superiority of Jewish children as manifested by larger scores with biographical material showing a large percentage of Jews participating as instrumentalists, he dismisses the advantage earned by Jewish children, basing his judgment on the inequality of the test situation. How this inequality works or what it actually is, he does not say. We are told that fear, anxiety, and nervousness are responsible for the low scores of the Negro, when they are low, but when they are high, as they so often are in rhythm, consonance and memory, no mention is made of fear, anxiety, or nervousness. The nervousness of the Jew is much more marked and yet it does not prevent him from scoring high. We are asked to believe that it is an asset to the Jew and a liability to the Negro.

Every good tester tries to eliminate such variables from the testing situation, for he knows that the child must be at ease when taking a test. The child must be relaxed and understand well what is expected of him before the test is administered. Inequalities may be found but they are usually associated with such extraneous considerations as uncontrolled noises in or outside the room; difficulties with the phonograph which may develop occasionally during the testing period; unclear or misleading instructions to those taking the tests; crowding too many children into too small a room; cheating on the part of the children taking the test; unhygienic conditions due to poor ventilation, uncomfortable seating and high temperature. Obviously, these are faults that must be avoided. No experienced tester would think of proceeding with a test under adverse conditions. If a child does not wish to be tested, does not take the test seriously or withholds his cooperation for one reason or another, his test score will be meaningless. It can not be said that the child was fairly tested, no matter how much effort and time were consumed in the attempt to do so, under adverse conditions.

In a Chicago Jewish orphanage and a Chicago public school, children numbering 550 were given both the Seashore and the Kwalwasser-Dykema Music Tests. The national and racial groups reported by Sanderson[146] are Jewish, German, Negro, Italian, and Polish. In order of standing, the Jewish group rated highest, followed by German, Italian, Negro, and last, Polish, who showed marked inferiority. In this study the Negroes earned the highest score in rhythm. The total mean scores of the Sanderson study follow: Jews 185.5; Germans 183.2; Negroes 180.6; Italians 178.4 and Polish 173.7.

The Witherson[188] study, a survey of all the children in the grade schools of Duquesne, Pennsylvania, numbering approximately 2,000 children, employed the Kwalwasser-Dykema Music Tests. More than a dozen different national and racial classifications were represented, and although the Sanderson and Witherson studies were conducted in communities separated by considerable distance the resemblances are striking. In descending order of achievement, the groups rate as follows: Jewish, native American, American foreign-born, Scotch-Irish-Welsh, German, English, mixed foreign, Serbian-Croatian, Russian, Polish, Hungarian, Lithuanian, Slovak, Italian, and Negro. The averages (means) of the Witherson study are presented for comparison with the Sanderson study: Jewish 185.9; German 183.5; Polish 180.5; Italian 178.2; and Negro 177.0. The Eneboe[32] study of 740 Chicago high school students yielded similar results with the same music test. Scandinavian, English, and German children ranked high; the Slavic group was about 20 points lower, and the Italian and Negro children were very low.

Finally, the author wishes to present Dykema's[29] study of ten European groups, numbering approximately 6,000 children of secondary school age, measured abroad. While on sabbatical leave from Teachers College, Columbia University, in 1930–31, he gave the tests in ten different countries under conditions that were maintained fairly constant from place to place. The countries represented in his investigation were: Germany, England, Scotland, Czecho-Slovakia, Russia, Italy, Hungary, Austria, Ireland, and France. It would be foolhardy to accept his results without qualification, for an average sampling of only 600 children in each country can hardly be considered adequate. Yet the study is unique and, as test populations go, rather authoritative. The total mean scores earned by the ten groups are:

Country	*Mean*
Germany	193.58
England	193.42
Scotland	193.42
Czecho-Slovakia	193.03
Russia	192.40
Italy	192.29
Hungary	189.25
Austria	188.98
Ireland	185.33
France	183.14
All countries	191.21

When we compare the scores of children abroad with those of our own country, we find that the average European child earns roughly ten points more. This difference is based upon the measurement of 4,250 American school children tested with the Kwalwasser-Dykema Music Tests about the same time that Professor Dykema was testing abroad. Statistically the difference is large enough to be considered significant. In addition, we note that foreign children show greater variation in their scores; European scores are more heterogeneous and ours more homogeneous. The standard deviation for all European children is 18.70; for American children 16.49. One-third of the children above the average and one-third below the average earn between 191.2 plus 18.7 and 191.2 minus 18.7. American children with their average of 180.9 show a variation of 16.5 above and below the mean. These scores showing less variation support the claims of anthropologists that hybridization is moving at a rapid rate in our country. Sharp national lines of cleavage are being eradicated to a great extent by the forty million immigrants who have settled here in a single century from 1830 to 1930.

While differences linked with nationality are weaker in this country, sex differences are stronger. Here the boys lag far behind the girls in scores earned on the music tests. The girls earn an average of 182.05; the boys earn an average of 179.7. In the Dykema study the difference, favoring the girls, is slight. The girls average 191.5 and the boys 191.1. In a later chapter, the author will deal with the problem of sex as revealed by test scores. Our schools may deny that a sex problem exists but by doing so we deliberately or unwittingly ignore the problem. Since the problem exists, it must be recognized.

In another respect the comparison of scores is challenging. The European and American children range in age from 9 to 19. Our children gain 1.35 annually, on the average, for the ten-year period. The European children gain 2.30, on the average, for the same ten-year span. The European children show 75% more achievement per year on the tests, with lower scores for nine- and ten-year-olds and higher scores for the remaining chronological levels. The interpretation of age differences will also be dealt with in a later chapter, but it is evident that we start strong and close this period weak, while European children reverse these characteristics. The annual and the cumulative chronological gains in American children are rather negligible, which supports the belief in the innateness of the traits under measurement and the unlikelihood of much change after the earliest years of adolescence. The same generalizations apply to the European scores, in spite of the 75% acceleration; the tests which measure basic traits such as pitch, rhythm, intensity, time, memory, and quality show very little change for the ten-year period. Most of the gain is registered in the remaining tests which measure the influence of learning rather than physiological function. The improvement in score is made in tonal movement and the two imagery tests which employ musical notation. Both abroad and here, the gains are insignificant on the tests that measure psychological rather than pedagogical traits.

Before terminating this chapter the author would like to clear some clouds from the testing horizon. We have commented on one of our difficulties — the size of sampling, which in most studies is meager. By and large our studies are completed in a semester or two by graduate students enrolled in a college program which yields a higher degree. The thesis or dissertation is an integral part of the program for the master's and doctor's degrees, but the research project is awarded only a limited amount of credits. Often the investigations are not too well planned or executed. Realizing that the populations under measurement are meager, the students refrain, commendably, from making far-reaching generalizations. With small samplings, interpretations of results warrant caution, but when many small studies are combined, collectively they may carry considerable weight. With increased numbers, trends and tendencies may be detected with greater reliability.

From time to time, the weight of evidence derived from objective measurement challenges established educational procedure. Too many experimenters have avoided issues by dismissing the facts and by so doing have rendered our music education profession a disservice. Too often the thesis and dissertation are considered exercises in research techniques, with the emphasis on acquiring skills to be used in subsequent studies. Unfortunately, later studies may never materialize, while the academic thesis earns the desired degree without contributing much to knowledge. Fortunately, it is easy to tell when the experimenter has made too much of little — or too little of much. Nevertheless, the experimental literature in the field of music psychology and music pedagogy is increasing rapidly, growing in size and worth. Only through experimentation and measurement may we acquire more accurate knowledge. We need the facts, and research promises to supply them.

3

Exploring Musicianship Through Measurement

MASS MEASUREMENT in music as in intelligence has established the fact that when test scores of large unselected populations are plotted, they produce the contour of the normal distribution curve. Furthermore, with an increase in the number of individuals tested, the curve, generally, becomes smoother and more normal in distribution. Every normal curve reveals two basic characteristics: the tendency toward homogeneity and the tendency toward heterogeneity. No matter what the test may measure, the scores tend not only to cluster around the middle of the curve but they also tend to spread out toward the ends of the curve. The central tendency which shows similarity or resemblance is expressed by such terms as mean, median, or average. Variation — the tendency to spread — is expressed by such terms as quartiles, standard deviations, centiles, etc. Regardless of the testing instrument used or the trait being measured, every large unselected population will show both tendencies, convergence and divergence, which are in opposition. The top and bottom scores are earned by the distinguished and the dull, respectively, who represent a small percentage of the total population. The undistinguished, the mediocre, or the average student is to be found in the middle of the curve. He is neither good nor poor — just indifferent. However, he and others like him outnumber the distinguished and the dull in all normal distributions. We associate the weight of numbers with mediocrity and central tendency. The prodigious spread of scores we associate with variability. Whether we measure intelligence, weight, height, size of heads, waist, feet, grip, finger length, hand span, music talent, or achievement, both homogeneity and heterogeneity are present in the plotted curve of scores.

Before going on, a very important difference must be made between talent and achievement. Frequently the two terms are used as synonyms but psychologists define the terms differently. *Talent* is the term used to denote native equipment, innate capacity — the possession of inherited structures that constitute one's potential. It is one's promise to achieve. The term *achievement* means accomplishment, attainment — that which one has acquired. Talent refers to the individual's start in life, one's capital, what one has to invest. Achievement refers to what one earns on his investment, such as dividends, interest, and the like. While one's achievement may vary with environmental factors such as the influence of training, motivation, and work-habits, little change in one's talent make-up is likely after maturation. Under normal conditions it is probable that one's achievement and one's talent are comparable, bearing more or less a one-to-one relationship. Little achievement may be associated with little talent, great achievement with great talent, and mediocre achievement with mediocre talent. If this were always so, we could accurately predict achievement from talent or talent from achievement. The one-to-one positive relationship does exist, as later studies will prove, but the inverse relationship also exists, as every music teacher is aware. For one reason or another, the disinterested but talented student may achieve very little; or the mediocre talent with the aid of superior instruction, strong work habits, and the will to learn, may achieve fairly good results. In both cases the inverse and not the direct relationship obtains.

The negative relationship may sound like a contradiction of values, but it is an educational fact both good and bad. It is a very common phenomenon in the business world when a smaller investment yields more than a larger one. If the rate of interest were constant, the return would always be proportional to the amount invested. We recognize two variables, then: (1) the "capital" invested and (2) the rate of "interest." Psychologically, an analogous situation exists with capital comparable to talent and interest comparable to achievement. When the dividend is low, one achieves only a cognitive limit, but when it is high, the physiological limit is being approached. Thus the cognitive and physiological limits make it possible to describe learning variations in relationship to quantifiable talent. If one always achieved or approached his physiological level we would have no need of cognitive levels, and achievement would invariably bear a one-to-one relationship to talent. It is the responsibility of the teacher and the pupil to approach the physiological limit with the minimum expenditure of time and effort. Unlike the business man, the student cannot borrow capital. He can only invest what he possesses, and if the yield is large it is chiefly because his talent is abundant and fruitful.

It must not be presumed that all talents warrant equal instruction nor that all would profit equally from instruction. An early study of music talent measuring of public school instrumentalists with the Seashore tests was made by Larson.[88] He tested children in elementary grades found in instrumental classes, and members of junior and senior high school orchestras. He found that scores increased as players advanced from lower to higher school levels, but the increase is attributed to talent and not age or training. The Seashore tests do not measure age and they do not measure training directly. Both considerations may be ignored, but not completely, for indirectly they do influence scores to some degree. The Seashore school of music psychology was obliged to make compromises with age values in issuing norms for talent tests, because older children were able to meet the testing situation better. They can follow instructions better, concentrate longer, resist distractions and are generally more at ease than younger children.

The author agrees with Seashore in rejecting the importance of these environmental factors, but realizes that they have a very special indirect significance as selective factors for the study of large populations. Since chapters are to be devoted to age and training, only a few sentences may suffice to characterize the effects of selection as they undoubtedly influenced Larson's investigation. All beginning instrumentalists are on trial, so to speak, for they must prove themselves worthy of instruction. Those who are unable to profit adequately by instruction become discouraged and in a short time discontinue taking lessons. When one's limitations loom large and failure humbles the child in the eyes of his classmates and family, the unrewarding project and its humiliations are avoided by quitting. Growing in musical proficiency and popularity, the successful seldom quit prematurely. With the passing of time the dichotomy widens. The poor and unpromising ones eliminate themselves or are eliminated, while the good ones grow in musical stature and self-satisfaction. Who can deny that, without testing, the discovery of the presence or absence of talent takes considerably more time?

We are all familiar with testing as a screening process employed by universities and colleges, admitting the better students and rejecting the poorer ones. But self-selection as just presented is probably not so familiar to the reader. Whether we recognize it or not, it is a positive force in education. At times, the parent or teacher, recognizing the futility of continuing music study may recommend more profitable non-music activity. At times the teacher may attempt to discourage the child when learning becomes difficult and disagreeable to both child and teacher. But for the most part it is not the teacher nor the parent but the child who decides the issue on the basis of what is happening to his ego. Quitting is a face-saving act which may involve the child's self-respect and his social status. So the superior talents remain in musical organizations which become more select with the passing of time. Training, in a sense, helps the child to discover whether he "has what it takes" or not. It helps indirectly to identify talent levels, but it is incapable of adding to or subtracting from the talent that the child possesses.

Not all who are superior continue music instruction, for a small percentage of the gifted in music find greater satisfaction in pursuing non-music activities. It is also a fact that not all who are inferior discontinue the study of music. Self-selection works widely and wisely even if it does not eliminate one hundred percent of the misfits. Parents and teachers, eager to salvage talent, urge children to work harder so that they may accomplish more. "Work and you'll succeed," they promise. Work has long been recognized as a virtue with so many overtones in the field of morality. The platitude virtually guarantees the worker achievement. In all probability work is neither a virtue nor a guarantee of success. Work, like age and training, bears no one-to-one relationship to achievement. In every studio and classroom in the land we find a representative proportion of children who work very earnestly and yet achieve very little in spite of their efforts. Restating the problem, we frequently find an inverse relationship between work and achievement. Again, the author wishes to remind the reader that the direct relationship also exists, for a fair percentage of learners achieve in amounts proportional to their industry and application.

We have already discussed the large number of children with inadequate music talent who discontinue the study of music due to disappointment with what they have achieved. Many of these children find that their work is unrewarding. While the number of such cases exceeds by far the number of prodigies in the music field, the case of the prodigy dramatizes the inverse relationship between the two considerations. Whether the individual achieves more for less work or less for more work, the relationship is inverse. Consider the child prodigy in music, launched on a musical career before the age of ten, dazzling audiences with his virtuosity. The "wonder child" has accomplished in only a few years what most music students are incapable of doing in a lifetime. The work of the prodigy as a performer approaches perfection; a mastery achieved in just a few years. There was no struggle with the techniques to be mastered, such as break the spirit of the less gifted. Little labor was expended in acquiring skills, so it may be said that the prodigy does not actually encounter too many problems. Seemingly, he overcomes them without encountering them. Ease and speed of learning seem to go hand in hand with excellence of learning. He accomplishes incredibly more with less instruction and work and in a fraction of the time. The phenomenal virtuosity of child prodigies makes the adult musician appear somewhat retarded. The older musicians have worked harder, longer, and have had more instruction, yet their labors comparatively accomplish less.

The prodigy represents a superior type of musician, possessed of infinitely greater music talent potential, along with the ability to achieve the highest standards of performance with a minimum of time, effort, and discipline. Whether prodigious or not, accomplishment will be circumscribed by talent limitations and such considerations as work, age, and training are each and all incapable of transforming a poor music prospect into a good one.

There are those in the music teaching profession who would place teaching ahead of talent as the more important conditioner of success. It is quite understandable that teachers and their state and national organizations glorify the teaching profession by stressing the importance of education. This observation is not made with the idea of casting disparagement on the teaching profession. Teaching is a powerful institution in the utilization of talent and, when expertly administered, it guides, directs, and encourages learning, making the maximum achievement possible.

In most of our college and university schools of music we find administratively imposed screening techniques in increasing number, which attempt to separate the musical "sheep" from the "goats." If good teaching could overcome talent deficiencies, screening designed to eliminate inferior ones would be an affront to our faculties. It is a fact that music faculties as well as admissions officers demand ever higher hurdles for entrance, and not all who apply are admitted. But it is in the private studios of our most distinguished applied music teachers that prospective students must prove themselves most thoroughly acceptable. These eminent teachers are too busy and too prosperous to gamble with poor material and their own established reputations, so they admit only those who are magnificently equipped to succeed. Since teaching is not the most remunerative profession, less successful teachers are obliged to accept students with or without talent, for more teaching means more income. The more affluent artist teachers, however, know the prowess of their teaching skills, yet they will not trust these skills unless the pupil possesses superlative talent. It is clear that they place the possession of talent ahead of their teaching techniques.

A few studies on the blind will enable the reader to better understand the point of view being presented.

Some years ago Dr. Seashore and T. L. Ling of the University of Iowa measured 16 blind students from the Iowa State School for the Blind, at Vinton, in localization of sound, discrimination of sound intensities, discrimination for lifted weights, discrimination for passive pressure, active pressure, and tactual space. The scores earned by the blind subjects were then compared with the scores earned by 15 high school students chosen at random from the Iowa City High School. In selecting the blind, only those were chosen who were totally blind for more than five years and who were otherwise both mentally and physically sound. All were high school students. The results favored neither group. "The blind and the seeing are, on the whole, equally sensitive to the direction of sound, intensity of sound, lifted weights, passive pressure, active pressure, and tactual space."

In the second study of the blind, the author [79] tested approximately one hundred blind children of the New York State School for the Blind, at Batavia, with the Kwalwasser-Dykema Music Tests. Since the last two tests of the Kwalwasser-Dykema battery require the use of music notation, they were excluded. When the blind were compared with the seeing, it was learned that the blind were only average in pitch discrimination, intensity discrimination, and tonal movement. They earned somewhat more than average for the seeing in tonal memory, quality discrimination, time discrimination, and rhythm discrimination. Yet their scores were ten percentile points below the level of eighth-grade boys and girls who receive musical training and are classified as trained. Compared with the scores earned by college students majoring in music, the blind are hopelessly outclassed. With vision seriously impaired and in many instances entirely lost, the blind are obliged to orient themselves to their environment chiefly through the sense of hearing.

If superior hearing were a compensation for blindness, then outstanding superiority would be revealed in their auditory test scores. Yet, in spite of this merciless type of motivation, which requires so much more from them in the way of auditory perception and punishes them so severely for auditory blundering, they fail to equal the scores of seeing eighth-grade boys and girls studying music. The cruel fate which has deprived them of vision must surely heighten the will to hear, but the will to hear, desperately strong as it must be, cannot change the structures that condition hearing. The slight advantage is probably due to cognitive rather than physiological factors, unfortunately, and it is trivial. If we accept motivation and the will to achieve as educational forces designed to help the learner to achieve more by raising the cognitive limit, we acquiesce, but it must be clearly understood that education does not transform, metaphorically speaking, base music metals into precious ones. We dare not delude ourselves into believing that one issued a 50-mile ticket will normally ride 500 miles.

The term "trained" was used in comparing the blind and seeing scores. The classification of "untrained" includes all children whose music education is limited to that obtained in the public schools and does not go beyond class-singing and the most elementary exercises in music-reading. Probably two-thirds of the school population are, in this sense, untrained. They are not members of instrumental groups, for they are unable to play a band or orchestra instrument nor have they had any experience with piano, accordion, etc. Their experience in music as a discipline is exclusively vocal. The trained classification, numbering approximately one-third of the school population, received the same kind of public school vocal discipline given the untrained but, in addition, they perform on a band or orchestral instrument. Many have studied the piano or some other non-band or orchestra instrument privately outside of school. Others, of proper age, have had some studio voice instruction. The line of demarcation between the two categories in all of our studies was arbitrarily drawn. In some of our studies, the classification of trained included only those who had received two or more years of formal instrumental instruction; in other studies, only one year of systematic instruction was required of the trained. But whether the line was drawn at two years or only six months of special instruction, the trained never failed to earn higher scores than the untrained on music talent tests. Without exception the trained are superior to the untrained in every study in which the two groups are compared.

In spite of the fact that the trained are significantly superior to the untrained, some individual test scores move out of line. Some children in the trained category earn less than others in the untrained category, which makes it unwise and inaccurate to predict *individual* scores on the basis of training. However, there need be no hesitancy in predicting *group* scores on the basis of training, for as a rule the trained group will be significantly superior to any comparable untrained group. The generalization may be made, by and large, that the trained *are* the talented and the untrained *are* the untalented.

It is no simple matter to establish the proper relationship of cause and effect between talent and training. The issue was anticipated in the discussion of selection and talent in an interpretation of the Larson [88] study. We believe that too often the values of talent and training are transposed, for talent is not the product of training. It is much more rational and realistic to maintain that training is a by-product of talent, for those possessed of talent seek and receive instruction. With few exceptions, those devoid of the necessary talent forego instruction or terminate it as soon as they can. The following report will confirm the author's point of view.

At the Eastman School of Music, Stanton [164] employed the Seashore tests to determine the relationship between talent and the changing enrollment at the Eastman School of Music, covering a four-year period. Teachers' estimates of success were also considered. Of 242 cases, 53% of the poor students voluntarily discontinued their music educations in less than a year; while 84% who were above average were in attendance at the end of the school year. Of 149 D or E (inferior and unsatisfactory) and 149 A or B (superior and excellent) students, after a three-year period, 87% of the D or E group were no longer enrolled in the school while 36% of the A or B group were no longer attending school. As a result of this study, Stanton reports: " . . . the faculty of the Eastman School of Music decided to admit only those whose music talent warrants some continuity of musical training."

In this survey approximately two and a half times as many students of inferior standing are compelled to or voluntarily break with the school compared with superior students leaving school. The privilege of pursuing four years of music education at Eastman is not extended to good and poor alike, and the same thing may be said for other music schools of rank. One must be worthy to be retained. So, in a very true sense, education seems to be a measure of the capacity to profit by instruction, which with reasonable reservations means that special education on higher levels is reserved for the talented.

Statistical measurements stratify society when measurable increments based on a common denominator are used. The intelligence quotient is just such a measurement, scaling approximately 100 levels of mentality. All the way from the genius to the idiot, the I.Q. is a convenient scale for differentiation. The average individual earns an I.Q. of 100 approximately. About one-third of the population will be found between 100 and 115; another third of our population will earn scores between 100 and 85. Only one-sixth of our population will earn higher scores than 115 and, correspondingly, only one-sixth of our population will earn I.Q. scores lower than 85. In the genius class are those who earn 135 and above, and they represent approximately one in 100 of our population. Half of the population is above and half below the 100 I.Q. mark.

Music tests also stratify society on a common denominator of 100 when the percentile rank method of evaluation is employed. The median score, the 50th percentile, draws a line of demarcation dividing the population into upper and lower halves. A percentile rank of 75 or higher places the individual no lower than the upper quarter. A percentile score of 90 places the individual in the upper tenth of the population. This method of evaluation reveals one's accomplishment as it compares with that of others who have been tested by the same instrument of measurement. Thus a percentile of 95 shows that only five people in every 100 equal or better such a score. The percentile scale is used as a basis of comparison, whether the test measures innate or acquired traits.

4

Music Talent and Intelligence

ALTHOUGH the word intelligence is clouded with equivocation, most educators know its gradations rather well. However, the task of defining the term precisely is, as yet, far from an accomplished fact. From the biologist's point of view it may be characterized as adaptation; and from the pedagogue's point of view it may be characterized as educability, the ability to learn or the power to think. Functionally, intelligence is the power to solve problems successfully. Numerous intelligence tests are used to determine quantitatively one's mental alertness. In general, measurements have shown that somewhere between fifteen and twenty years of age, and in some cases much earlier, mental growth ceases. Thereafter it may retain its maximum level or decline gradually. Sharp drops are noted after fifty-five and sixty. It is fairly clear, too, that lines for different individuals, when plotted, run parallel. Whoever is ahead at some early age will normally retain his advantage for the rest of his life. These are the significant facts regarding age and intelligence contributed by the research of Kuhlmann,[78] Slocombe,[155] Baldwin and Stecher,[4] Chamberlain,[22] Foster and Taylor,[36] and many others.

As distinct from knowledge, intelligence stands out as a congenital character. "Let us admit that the mind of man is for the most part a congenital product and the factors that determine it are racial and familial," states Pintner.[131] "We are not dealing with mutable characteristics capable of being moulded by the doctor, the teacher, the parent or the home environment. These may provide the material upon which it can act and give a welcome scope for its activities, but they do not create it." This position is consonant with that held by the author and presented in earlier chapters. Great individual differences are found at all ages and any generalizations concerning the intelligence of individuals, when only their chronological ages are known, is hazardous.

When 1,000 children were examined with the Stanford-Binet Intelligence Test, the distribution of scores was found to be fairly symmetrical for each age level from five to fourteen. Terman [174] found that the I.Q.'s for the middle 50% of his population ranged from 93 to 108. Among unselected school children he found gradations of intelligence from the feeble-minded to the genius. In large populations he found that for every child of any given degree of deficiency, there was another as far above the average I.Q. as the former was below. The variability in mental traits as shown by I.Q.'s is practically the same from five to fourteen, for five-year-olds differ from one another fully as much as fourteen-year-olds do. When the population was compared by sex, he found a consistent superiority of the girls over the boys up to the age of thirteen. The boys overtake the girls at the age of fourteen. The distribution of intelligence in boys and girls is approximately the same. The fact that fewer women attain eminence in after-school life cannot be due to their lack of intelligence. In evaluating social status he found that children classified as superior earned seven points above the median, while those classified as inferior earned seven points below the median. He points out that social superiority and inferiority are linked in all likelihood with original endowments of superiority and inferiority.

From the beginning of music education in American schools, more than one hundred years ago, music teachers have been on the defensive, for music is a controverted subject. Even today it is considered a "frill" by conservative school people. When school programs are curtailed, as they have been from time to time, music is likely to be one of the subjects dropped from the curriculum. The extravagant mind-training claims made for music by music educators somehow fail to impress the school administrators. These claims have no basis in fact. But whether factual or fictitious, the mind-training claims for music have not abated. "Music teaches the mind to move," wrote Giddings.[47] "Music rightly taught is the best mind trainer. If deeper and more logical thinking is desired, a course in harmony, counterpoint, composition and other studies in the theory of music may well be pitted against mathematics as a means of intellectual development."

More recently, Dr. James Mursell[113] of Teachers College, Columbia University, has sponsored the mind-training claim. "The typical musical person," as appraised by Mursell, "has a high-grade mentality and shows much versatility, particularly in literary fields." Another of his claims links music and mathematical ability. "Musical ability," he maintains, "is a manifestation of a general level of all-around ability and is linked with general excellence." These spurious claims have no foundation in fact. They are compensatory and have their source in the far-from-flattering attitude of non-musicians in institutions of learning. The claim never has been, nor can be, substantiated scientifically and it should be denounced by music educators in the interest of truth. Before we present the evidence of objective measurement on the subject, a few quotations seem apropos.

"Is it not a fact that really fine musicians may be developed emotionally a little more than they are intellectually?" asks Newton.[117] "Indeed, it is almost necessary that those whose function it is to awaken the deepest emotions through music, perhaps unconsciously, to find themselves in this condition." Trotter [180] wrote, "I find that there are many people who think if you have a musical education you have at least an education and so have nothing to complain of, as though all forms of education were fundamentally the same and equal in value. Music offered as an education foils education." Benedict [9] wrote, "I was early taught that music was not only an intellectual occupation of the highest order but engaged the mind sufficiently for every purpose of development. Later I discovered that this was but the cant of an esthetic dogma, or putting it more mildly, an error that grew out of the boundless enthusiasm of the over-ardent proponents of the art. In Europe, a virtuoso is not expected to give particular attention to such ulterior matters as reading and writing. It embarrassed Europeans not in the least that their greatest virtuoso, the renowned Paganini, was a veritable marvel of illiteracy. Knowledge fares hard because music has no use for it. Therefore, if the musical virtuoso desires to gain what music has no use for, he will have to make definite terms with his art and stand by certain necessary reservations."

Scientific studies dealing with the relationship between intelligence and musicianship reveal that the two considerations are quite independent. Hollingworth [65] measured children in New York City schools whose I.Q.'s were between 135 and 190 and whose ages were from nine to eleven and one-half years. These children of the mental genius level were given the five Seashore Measures of Musical Talent and their scores were subsequently compared with the norms. The results showed that only 21% exceeded the 50th percentile in pitch discrimination; 45% exceeded the 50th percentile in intensity discrimination; 65% exceeded the 50th percentile in time discrimination; and 50% exceeded the 50th percentile in consonance and 53% exceeded the 50th percentile in tonal memory. The average percentile scores for the Seashore tests follow:

Test	*Average Percentile*
Pitch	47
Intensity	50
Time	58
Consonance	48
Tonal Memory	52

Hollingworth[65] concluded that "Intellectually superior children are not superior in music sensitivity, for the tests are not symptomatic of intellectual development above that required for understanding and executing the tests."

Over a period of many years, Syracuse University's Admissions Director required all freshmen and transfer students entering the university to submit to tests during the week preceding the opening of school in the fall. The test scores which follow are based on the Ohio State University Psychological Examination, which all applicants were obliged to take regardless of the school or college of the university to which the student sought admission. In the Fine Arts College at Syracuse University are three Schools — Architecture, Art, and Music. In mentality, as measured by the psychological examination, the three groups are individually and collectively inferior to Liberal Arts students. The mean for all Fine Arts students was found to be 113.5 as contrasted with a mean of 124.5 for Liberal Arts students; a difference that is statistically significant and cannot be attributed to chance. Within the Fine Arts divisions of Architecture, Art and Music, the scores descend sharply from Architecture to Art and from Art to Music. Since the School of Music of the Fine Arts College of Syracuse University is a professional school, it is more concerned, naturally, with musical than with mental equipment. The Music prospect approaches the average while the Liberal Arts prospect approaches the superior level mentally. Year after year, confirming evidence of this kind is collected.

The superiority of the Liberal Arts student vanishes when he is tested musically. He is just as mediocre musically as the music student is mentally when test scores are compared. The mental superiority of the Liberal Arts student is unable to overcome his weakness in those traits measured by music tests. On the Kwalwasser-Dykema Tests, the Liberal Arts students average 30 points less than do the School of Music students. The Liberal Arts student earns no more on a music test than does the average high school student, nor is there any good reason why he should. If he were the equal of the music student, he would probably seek admission to the Music School and not Liberal Arts. The music talent difference between the two groups is colossal, just as the mental difference is one of substantial magnitude.

We are aware that superior intelligence does not help the Liberal Arts student earn a higher score in music, any more than superior music sensitivity of the Fine Arts music student helps him earn a higher score on intelligence tests. The reader may also be aware of some attempts by music students to rationalize the difference in mental and academic scores, attributing as causes, such considerations as pre-occupation with other activities, lack of time and energy after the drain of too many rehearsals, hours spent in practice on voice or instrument, lack of interest and others. There can be no denial of the fact that the music student places his music objectives ahead of academic ones and is painfully aware of his divided loyalties and responsibilities. The music student pursues music, quite naturally, because he is well equipped and well rewarded for doing so, but in the non-music academic courses his rewards are meager. It is reasonable to assume that an individual seeks and realizes what he is most capable of doing and avoids activities that reveal him as being inadequate. From music study he derives pleasure, but from academic training only the humbling of his pride and disappointment.

Furthermore, the music student may just be realistic and shrewd enough to know that academic prowess may not pay the dividends that music disciplines pay. He may argue that the direct route to a musical career calls primarily for skills in music and these skills must be acquired. The academic courses may have some indirect bearing; but, aside from the necessity of earning passing grades, they represent remote if not unrelated values, he reasons. So musical activities are undertaken with devotion and drive while academic activities are regarded as something of a devious diversion. Our Liberal Arts faculties may not be inclined to condone such reasoning but it makes sense just the same.

We will devote the remainder of the chapter to a review of research dealing with intelligence and music test scores. Now we wish to present material of a biographical nature bearing on our problem. In the study of 300 geniuses by Cox,[175] the biographies of a number of great musicians were investigated, including Bach, Beethoven, Gluck, Handel, Haydn, Mendelssohn, Mozart, Palestrina, Rossini, Wagner, and Weber. These and others were rated on a number of personal traits which show the characteristics of great musicians of the past. Compared with the others (non-musicians) they rated lower in intellectual activity, the intellectual-social and the physical traits. They rated higher on emotional traits. In one category, namely "skills in and devotion to athletics and sports," the musician earned a score of minus 1.6, while the average of plus 30 was earned by the total population of 300. Musicians appear to be eight times as variable as the average in oscillating between extremes of cheerfulness and depression. They are twice as excitable as the average; one-third as constant in friendship to persons of the same sex and half as constant to persons of the opposite sex; two-thirds as loyal to friends or causes and one-third as conventional.

More recently, White [175] made a further study of the versatility of Cox's three hundred geniuses, using biographical records for each subject to determine competence in 23 different fields. The mean versatility index was highest for non-fictional writers, statesmen and philosophers with a score of 7.5. The score was lower for scholars, religious leaders, scientists, poets, mathematicians, novelists and dramatists, being approximately 6.7. The score earned by soldiers and artists was slightly above four, and, the lowest of all subjects studied, the musicians earned a score of only 2.7.

A unique contribution to our problem appeared in a novel work, "Diseases of the Musical Profession," written by Singer [154] and translated from the German by Vladimir Lakond. While music therapy makes use of the regenerative and stimulating influence of auditory experience, we are quite unconcerned with the price paid by the musician who lives in a world of sound. To understand the status of the musician, Singer presents a few basic biological and psychological considerations. It is the structure of an organism which determines its function. The individual instinctively seeks some type of work in a sphere that is pleasant. In the choice of any profession, the intellectual and physical constitution of the individual is a most important factor. The athletic type, as we learned earlier, is virtually absent among musicians of superior talent. Brilliant musicians are constitutionally weak, yet upon them fall enormous physical and emotional burdens. Continuous over-taxation in music creation and interpretation, makes the profession a menace to the constitution of individuals so encumbered. On the other hand, Dr. Singer contends that individuals of average talent are not so likely to exhaust themselves, for they preserve their physical comfort and maintain a better balance between energy-absorption and energy-production.

After discussing the inadequacy of the term "nervousness," Dr. Singer, formerly medical attendant of the Municipal Opera Company of Berlin, gives us a characterization of the professional musician that should be enlightening. "In order to play music," he writes, "to live with music and become engrossed in its technics, its essence, its form, and its ideas, one needs an especially attentive, impressionable, sensitive nervous system. Continuous irritation through tone stimuli from without, through still unbroken provocations of fantasy and inner formation, constantly increase the physiological tension of the brain and of the nerves or organs dependent on it. An enormous reduction of nervous matter and a gigantic process of transplantation in the cells of the cerebral cortex takes place. Vasomotor disorders appear; the heart throbs quickly, speeding breathing, the face turns red, the skin becomes moist, the eyes glimmer, sensations of fear and dizziness overtake the individual and memory may be obliterated. All of these symptoms — irritability, fatigue, indispositions, ill humor, headaches, insomnia, and memory failures — are conditioned through a disturbance of the energy pattern and capacity in the constitution. The balance between the absorption of and the release of power is not adapted to the individual's physical structure."

He concludes the discussion of nervousness with the following generalization: "Music is not the cause of these constitutional disorders, but those whom it attracts are potentially nervous. These disorders, potential or prevailing, are by nature heredity weaknesses which would reveal themselves regardless of the profession pursued." Again, the reader may find that the popularly accepted cause and effect sequence has been transposed, but Dr. Singer is quite right. We wish to call attention to the fact that these symptoms are those which would be classified as emotional rather than intellectual behavior. Music is often defined as the language of emotions. If we accept this definition of music, there can be no objection to the characterization of the musician as the manipulator and resonator of emotions, for authentic emotional expression must be preceded or accompanied by emotional impression.

Granting that musical activity is predominantly emotional by nature, Whiteside's [184] investigation will be of interest. He found that unstable emotional conditions tend to lower the achievement of school children. By using teachers' judgments and the Woodworth Questionnaire, he was able to determine the high and the low emotional quartiles of his population. He then paired the children by age, sex, and I.Q. "We may conclude," he states, "that when two children of the same sex, mental age and chronological age are compared, one emotionally stable and the other unstable, the latter is only 90% as efficient mentally as regards achievement in elementary school subjects as the former." This study merely confirms what we observe in everyday life; emotional excitation disturbs normal thought processes. If we stop to consider the biological significance of emotions, we cannot fail to understand why the intellect is checked.

Emotions move us, hence the word — to move out. Under intense emotional stimulation such as anger and rage, the thought processes are inhibited or checked while the individual acts. Such characterizations as unreasoning fear, blinding rage, fuming anger, etc., tend to show how the reasoning powers are by-passed. Strongly marked frown, glaring eyes kept violently open, sometimes protruding from their sockets, veins distended and gorged with blood, face reddened, heart and breathing rate greatly accelerated, nostrils dilated, mouth firmly closed, teeth ground together; these are the familiar patterns of response linked with strong emotions. These behavior patterns are the very antithesis of those associated with a thinking individual. It must be nature's plan to keep an emotionally aroused individual intellectually dormant for his own protection. The autonomic nervous system takes over when the central nervous system abdicates. In a crisis one is not permitted to think.

In a crisis emotions and instincts are far more trustworthy than one's intellect, biologically. They have been tested and tried over a much longer period of time than the intellect and have been responsible for man's survival. Primitive man survived because he could feel and act and, it seems, present-day man must follow the same pattern. Survival in a crisis calls for speedy and certain action. The unpredictable, uncertain and untrustworthy processes of thinking consume precious time. But the major difficulty with thinking is that it delays action such as fight or flight and the loss of seconds could mean certain destruction. To survive, the individual must act as the race has acted, using the inherited patterns retained through organic memory and tested by time. If he thinks as an individual he may depart from the inherited pattern and be lost. If he "loses his head" his chances of retaining it are enhanced. Simplified as this sketch is, it puts the two functions in their proper biological setting.

Feeling inhibits thinking and reduces its efficiency. This generalization is as true of modern as it was of primitive man. The older brain, which controls the autonomic nervous system and takes over for the newer brain, is to be trusted when survival is at stake. By temperament the musician is emotionally so constituted that he experiences and expresses feelings sympathetically and sensitively. To meet and overcome problems in the field of music, the musician needs the disposition to emote. While some may argue that the musician possesses both a high-grade intelligence and high-grade emotionality, we maintain that this position would be more tenable if emotionality were reduced in intensity. Statistical studies showing the extent of linkage between intelligence and musicianship as measured by objective tests will conclude this chapter.

Robertson[139] tested 5,013 children in six geographically scattered cities for both intelligence and music talent. The cities were Syracuse, Buffalo, and Ilion, all in New York; St. Francis and Hutchinson, Kansas; and Roswell, New Mexico. He used the Kwalwasser-Dykema tests for measuring musicianship and the Otis, Binet and Kuhlmann-Anderson tests for measuring intelligence. The intelligence test scores were then correlated with the music scores of all subjects tested. His population came from grades 4 to 12 and ranged in age from 8 to 20 years. By sex, the boys and girls were approximately 1½ I.Q. levels apart.

Sex	*I.Q. Mean*	*K–D Percentiles*	*Number*
Girls	102.61	50.1	2,477
Boys	101.04	47.0	2,536

When the music scores were correlated with the intelligence scores for the total population, the coefficient of +.33, ±.008 was found. This correlation is reliable statistically but low, in spite of the fact that four of the ten Kwalwasser-Dykema tests measure traits that are influenced by training and are, strictly speaking, achievement tests rather than talent tests. Achievement tests correlate rather well with intelligence, for, among other things, they measure the power to profit by instruction. With the elimination of the four tests influenced by training, the correlation coefficient would be depressed very considerably. Any prediction of intelligence based on music talent or music talent based on intelligence would be so inaccurate as to be most misleading, since there is only a 6% accuracy in a correlation coefficient of +.33.

Two other correlations were computed for the upper and lower 10% of the population under consideration. Segregating the highest music scores earned by 500 of the more than 5,000 population and comparing the intelligence and music scores for each subject, a correlation of only +.22 was obtained. This correlation has a prediction value of only 2½% accuracy. The lowest 500 music scores yielded a correlation of only +.05 with intelligence and a prediction accuracy of zero. With low correlations between music and intelligence scores, we can expect very little linkage or resemblance between the two considerations. This fact can be demonstrated clearly.

The average music scores for the top and bottom 10% referred to above are separated by 90% of the population. This is the difference in mean-achievement, musically, but when we compare the intelligence scores of the two groups by computing the means and noting the disparity, they are separated by less than 40% of the population. Using the intelligence scores as a basis of selection and segregating the best and poorest 500 mental scores and their achievements in music, we discover that the best minds (top 10%) regress to the 58th percentile in music, while the poorest minds (lowest 10%) advance to the 25th percentile in music. To summarize, a mental difference of 90% of the population is accompanied by a population difference of less than 33% musically. The distinguished individuals with an I.Q. average of 127, which places them on the 95th percentile, recede from their place of eminence mentally to a position of mediocrity in music with a percentile rating of 58, only 8% above the median. The poorest 500 cases earn an average I.Q. of only 75, yet their music test scores are 20 percentile points better than their I.Q.'s. The best minds are 37 percentile points poorer in music than in intelligence, while the poorest minds are 20 percentile points better in music than in intelligence.

Some fifty years ago Francis Galton [38] discovered from his measurements of height when comparing parents and offspring, that very short parents had short children and very tall parents had tall children. But the short children were not as short as their parents and the tall children were not as tall as their parents. The law of regression in the study of inheritance revealed that the variations in mass measurement moved away from the extremes toward the mean of the curve. Our correlation studies linking intelligence with music measurement display the tendency toward mediocrity, also. Whether we take high or low mentality, or high or low music equipment as the point of reference, the linked trait may remain on the same side of the mean but tends to approach mediocrity or the 50th percentile. In other words, fine minds are not so fine musically and poor minds are not so poor musically. Fine musicians are not so fine intellectually and poor musicians are not so poor intellectually.

In a study by Chase,[23] the scores of 82 feeble-minded children, inmates of the Syracuse State School, were tested with 8 of the 10 Kwalwasser-Dykema Music Tests. The scores show how strong the tendency toward mediocrity is. These sub-normal children averaged 13.9 years of age and were still attending the elementary grades from 1 to 4. The highest I.Q. earned by one of their numbers was 77 and the lowest 45. As a group they averaged only 64.7, a mental level so low that only one child in every 100 is so deficient in intellect. Yet this feeble-minded group earned an average score of 49.4 in the tonal movement test. A score of 50 in percentile rank is the median for normal individuals and the average percentile rank for the 8 of the 10 K-D tests was 35, only 15 percentile points away from the average achievement of normal school children.

In mentality these children were 49 percentile points below the average; in music scores they were only 15 percentile points below the average. It is fortunate for both society and these mental defectives that their sensory powers have not deteriorated as much as their rational processes. This makes it possible for these children to take part in and enjoy musical activity to a degree that would be quite impossible if this regressive tendency were not present. In other words, their mental deficiency is, fortunately, not equalled by anything that is comparable, musically. It may explain why children in ungraded groups (sometimes called "opportunity" groups) enjoy music more than the academic courses in which they are so pitifully weak.

Employing the Otis Intelligence Tests and the Kwalwasser-Dykema Music Tests, Newkirk [116] correlated scores earned by more than 1,000 children. The correlation coefficient obtained was +.34 for the total population, which contains a prediction error rate of 94%. When we compare the music and intelligence scores for regression, we find that the highest 10% of the population in music earn an average of 81 in percentile score, a decline of 12 percentile points. The lowest 10% of the population in music earn an Otis rating of 43, gaining 38 percentile points over their music score. The enormous separation of the two extreme ends of the curve in music equalling 87 percentile points is cut to only 38 percentile points in intelligence.

If we divide our population on the basis of Otis scores into quartiles and compare the quartiles above and below the median or 50th percentile rating, the music lines do more than merely approach the median point in regressing. They actually cross the median line. The Otis average above the median of 60 drops to 49 in music, while the Otis average of 35 below the median crosses the median line and attains a level of 65 in music. The 15 below average quartile goes to a 15 above average level in music and the larger difference of 25 points in the Otis Test scores is accompanied by a difference of 16 in the K-D Music Test scores. The two quartiles are more heterogenous mentally than they are musically. Here we have one of the reasons why the coefficient of correlation is no higher than +.34.

Using the Kuhlmann-Anderson Intelligence and the Kwalwasser-Dykema Music Tests, Mooney[109] measured 513 sixth grade children in the Montclair Public Schools of New Jersey. Again the correlation of +.34 was obtained. In a study of 544 junior high school children in the Roosevelt Junior High School of Syracuse, New York, Wise[187] correlated the music scores and the Otis Classification Test scores. Again the correlation of +.34 was obtained. Correlations for the individual music tests such as quality discrimination, intensity discrimination, rhythm, time and pitch discrimination are less than half of this quotient, while tests that yield more to training are only a little higher in relationship but less than +.34.

At the University of Arkansas, 230 students were given the Seashore Measures and the Otis Self-Administering and Army Alpha Tests. As we have observed, correlations are much lower for the Seashore Measures than those computed for the K-D Music Tests, since the Measures are not influenced by training — being primarily auditory by nature. These tests yield approximately the same correlations as those computed for the auditory tests of the Kwalwasser-Dykema battery. The Seashore correlations are: intensity +.01; time +.13; consonance +.09; rhythm +.12; tonal memory +.10; pitch +.12. Therefore, any prediction of intelligence based on the Seashore Measures is likely to be almost 100% in error. The authors[37] confirm the stand taken by Seashore that "music tests are not intelligence tests."

Those who claim that musical superiority is accompanied by mental superiority will derive little support from the statistical studies in the field of music psychology. These studies tell us that the relationship between the two considerations makes prediction guesswork. In approximately 95 times out of 100, the prediction of intelligence from the Kwalwasser-Dykema scores will be wrong. In practically 100 times in 100, the prediction of intelligence from the Seashore Measures will be wrong.

If the presence of one value were accompanied by the absence of the other value, a negative correlation would exist. Such would be the case, for example, if a high I.Q. were accompanied by a low music score and as one increased the other decreased. We do not find our values related in this extreme way. Our study of regression shows that a degree of repellency exists with the middle of the curve acting with magnet-like attraction, but unequal in force for the two halves of the curve. It may be said that the repelling force toward the average is about twice as strong below as it is above the median. Those who earn the lowest scores in X (intelligence) will be almost average in Y (music), while the highest X scores are linked with not so high Y scores.

5

Music Talent and Age

THE INFLUENCE of age upon music talent is a consideration of utmost importance to music education and requires thorough study. Some think that time, somehow, will eradicate deficiencies, but time may be on the side of those who *have* rather than those who *have not* talent. Does time compensate the deficient? The answer may be found, partially, in the Binet mental measurement technique, now the standard method of evaluating intelligence. Realizing that an individual's chronological age is, in itself, no index of brightness or dullness, the educational world has turned to mental age to more adequately appraise one's intelligence. The intelligence quotient is based upon the assumption that a certain level of mentality goes normally with a certain age level. Therefore, the intelligence quotient is the ratio between the mental and the chronological ages obtained by dividing the former by the latter. When the discrepancy between the two ages is slight, the quotient approaches the normal level and its value is approximately 1 or 100. For those who are mentally retarded, the mental age is lower than the chronological age and yields a quotient less than that earned by the average. Where the mental age is greater than the chronological age, the quotient will be greater than 100. All other things being equal, the larger the chronological age the smaller the I.Q.; while the smaller the chronological age the higher the

I.Q. This inverse relationship proves the inadequacy of chronological age as a measure of mental alertness.

Our schools are responsible for many misconceptions regarding chronological age. They promote children by age rather than by intelligence, in spite of the fact that the brighter children are held back and the dull ones advanced beyond their actual capabilities. As our educational system functions, the brighter child is actually the "retarded" child, for he is not permitted to advance at the rate nature intended. For the sake of "smooth" administration, the superior child is thus sacrificed. Whenever age and intelligence are studied objectively the oldest children in the grade are found to be inferior and the youngest superior. But whether the individual is inferior or superior, his I.Q. tends to remain rather constant — at a level that is relatively fixed. The constancy of the I.Q. has been experimentally established by Honzik,[67] Terman,[174] Gates,[43] Goodenough,[49] and others.

The detrimental influence of age on college education was reported by Smith [157] after a careful study of 528 Syracuse University students who did not graduate. The ages are those at the time of matriculation for the Class of 1935. At the age of 16 or under, only 28½% of the 528 students under investigation withdrew. This percentage was the lowest for the entire population. The highest percentage of withdrawals was found for the oldest group, the 20-year and above level which showed a withdrawal rate of 54%. Between these extremes the rate increases with age; 44% for the 16–17½-year-olds; and 45% for the 17½–19-year-olds. Almost twice as many 20-year olds and above withdraw as compared with the 16-year-old level. Smith concludes: "Apparently the older the students are at matriculation, the greater the probability of their withdrawing prior to graduation."

In a closely related study, based on the records of the matriculates of September 1931, numbering 1,112 students enrolled in both undergraduate and graduate schools of Syracuse University with the exception of Forestry, Smith[158] correlated age and honor-point averages. The University uses a 5-letter marking system and each letter carries an honor-point weight. An A earns 3 honor-points, B 2 points, C 1 point, and D no points. An A grade in a 3-hour course entitles the student to 9 honor-points. Using the total number of honor-points as a criterion of scholarship and dividing the sum by the total number of credit hours carried, the average honor-point value for every student was computed. As might be expected, the correlation with age showed a negative coefficient of −.37 indicating that there is a tendency for younger students to earn higher scholarship ratings than older students.

Sommerville's[160] physical measurements reveal that "college freshmen are slightly the tallest group in college and their arms are the longest. Freshmen and sophomores together have the longest legs. The freshmen chest circumference is exceeded only by that of the seniors, as the latter have greater weight. This may be due to extra flesh and not to greater cross-section of skeletal framework. The freshmen have the longest faces, noses and chins and the greatest gonial angle; together with the sophomores they have the biggest jaws and the highest vital index. It may be noted also that the youngest class has the steadiest hands, is best in judging weights, is more accurate of hearing and has the keenest vision." These signs of physical deterioration in college students have been noted by many investigators as a trend that sets in before the age of twenty.

When our ears grow old, they, too, operate less effectively. Sensitivity to higher frequencies is lost or impaired but the hearing of lower frequencies is not much changed. In a series of audiometer tests on 353 hospital patients conducted by Bunch,[18] the loss of sensitivity to hearing linked with advancing age is clearly shown. Beginning with 1,024 vibrations per second ("high" C) the oldest group required approximately a 13 decibel increase over the 20-year-old group to register the sensation of sound. Just two octaves above, at a frequency of 4,098, the difference in sensitivity between the 60-year-old level and the 20-year-old level increased to 40 decibels. Hardness of hearing increases with both age and frequency, for hearing degeneration goes normally with advancing years whether we accept Bunch's hospitalized subjects or Montgomery's non-hospitalized subjects.

Both Bunch and Montgomery [108] are dealing with an age differential of 40 years. We attribute the substantial loss in hearing efficiency to the ravager, age, but if we substitute adolescents for 60-year-olds and a variation of 50 months for 40 years in age, the trends are quite comparable. We measured 914 seventh-grade children with the Kwalwasser-Dykema Music Tests and recorded their achievement by age. Starting with the oldest and descending to the youngest seventh-graders, we report age and music score for the population by increments of six months. As their ages increase their music scores decrease. The addition of 50 months in age is accompanied by a drop of approximately 15 points in score.

Age in Months	*Music Score Mean*
184–above	170
178–183	175
172–177	177
166–171	174
160–165	177
154–159	181
148–153	182
142–147	190
136–141	184

The author first encountered this problem in the Madison School of Syracuse, New York. We administered music education on a basis of homogeneous regrouping that promised to achieve better results. We reclassified 207 children of the 7th and 8th grades for music instruction, disregarding their "home-room" assignments, on the basis of talent and achievement tests in music. The test scores for all were recorded and the entire population was rearranged in progressively descending order from highest to lowest scores. The two batteries of tests used were the Kwalwasser-Dykema Music Tests and the Kwalwasser-Ruch Musical Accomplishment Tests.* Ignoring such considerations as sex, age, grade, training, interest, intelligence, etc., we proceeded to organize six different classes of approximately 35 children each, in which measurements proved the children to be more or less homogeneous. The first group consisted of 35 7th- and 8th-grade children earning the highest scores; the second group consisted of 35 7th- and 8th-grade children next in order. As soon as a class numbered 35 members, it was closed and an inferior group organized. Thus the 207 children were assigned to their proper classes for music instruction. The classes were identified by number; Group I contained the best in talent and achievement while Group VI contained the poorest in both talent and achievement.

It was only a matter of days before we observed that our method of selecting the children for the six levels of talent and accomplishment stratified our population, unwittingly, in regard to chronological age and sex. Group I averaged only 12½ years of age and Group VI averaged 15¼ years, a difference of 33 months. When we realize that only two grades (7th and 8th) were involved in our experiment, the age averages separated by $2\frac{3}{4}$ years becomes a weighty consideration. Within a grade we have a fairly wide spread of ages represented. Our measurements show consistently that the lowest scores are associated with the older children and the highest scores with the youngest children. This inverse relationship is found almost without exception. It is found whenever a large grade school population is being studied and it is present whether we measure music talent or music achievement.

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* Kwalwasser-Ruch Musical Accomplishment Test, published by the Extension Division of the State University of Iowa, Iowa City, Ia.

When we take a "horizontal" sampling of a grade or a level, such as the junior high school or the senior high school, the relationship between chronological age and music test scores is inverse and markedly so. However, when we take a "vertical" sampling of a wider spread of grade levels, we find that scores tend to increase as the grade level ascends. The increase of the fifth grade, for example, over the fourth; and the sixth grade over the fifth is so small in contrast to the strong inverse relationship within the grades that statistical studies yield inverse values between Kwalwasser-Dykema scores and age regardless of the range of grades and ages represented. The same generalization may be made for the Kwalwasser-Ruch Test, which measures musical knowledge required in music reading. We learn that the average high school student doubles the score of the average 4th-grade child on this test, in a period of eight years. This achievement sounds quite impressive until we discover that there are children in the 4th grade too, who double the average 4th-grade score. In spite of the fact that this achievement test measures the effects of training and is influenced by intelligence, the "vertical" variation during the public school life of the child is minor, compared with the "horizontal" variation of scores.

The Witherson research,[188] reviewed earlier in part, seems especially significant at this point. The reader may recall the Duquesne, Pennsylvania study of 1,992 children from the 4th grade through the 12th with the Kwalwasser-Dykema Tests. Peak scores were earned, not by the oldest children, but by the 14-year-olds. The older children failed to maintain the high level represented by this group as the Table shows. Over a 9-year chronological span, the population actually improved five points on the average for approximately ½ point per year per student. When we realize that selection is at work on the high school level, the ½ point per year decreases in value, but we cannot say how much.

Age	*Mean*	*Sigma*	*Number*
9 & 10	176.84	13.60	235
11	178.48	13.95	321
12	179.75	14.70	378
13	183.51	15.05	363
14	185.45	15.60	407
15	182.18	16.00	203
16–19	182.14	14.45	85
Totals	181.40	15.10	1992

The correlation coefficient computed by Wise[187] for 700 junior high school children, ranging in age from 11 to 17½ years with Kwalwasser-Dykema scores was −.56. Again the younger children earn the higher scores and the older ones the lower scores. The youngest and oldest 10% of the population represents an age difference of 5⅓ years and a music score difference of 11 points in favor of the younger group. The following compilation of scores shows how 4,250 children, ranging in age from 9 to 20, are distributed chronologically.

Represented in this Table are children from the intermediate grades (4, 5 and 6); junior high school (grades 7, 8 and 9) and senior high school (grades 10, 11 and 12).

Three plateaus are present in the Table, the most conspicuous being the middle one formed by ages 12, 13, 14, and 15, for which our scores show an increase of approximately 2 points. But the significant fact about this Table is its revelation of small change with age. It discloses the fact that during the dozen years under investigation, the rate of advancement is approximately 1⅓rd points a year.

Age	*Mean*	*Sigma*	*Number*
9, 10	174.30	15.60	432
11	176.78	14.90	471
12	180.02	15.25	651
13	180.11	15.80	710
14	180.40	15.83	631
15	181.83	17.35	513
16	185.78	16.30	387
17	188.40	17.45	234
18 & over	187.65	16.46	144

Because of this slight "vertical" increase in scores, test builders have segregated groups by school grade or chronological age and frequently by sex to obtain a more convenient evaluation of test performance. We have issued norms for four different school levels and a fifth set of norms for college music majors. The four school levels are (1) intermediate grades, (2) junior high school, (3) senior high school, and (4) non-music college students. While college non-music and music students represent practically no difference in age, there is a world of difference in scores on the Kwalwasser-Dykema Music Tests. A difference of 25 points separates the two groups, necessitating the use of music and non-music norms to evaluate individuals representing the two groups in achievement.

Here we find that vocational classification rather than age is responsible for the enormous disparity between the two groups, necessitating special norms for the most distinguished level of test performance. Although the issuance of norms or standards on a grade or age basis may give one the impression that talent is conditioned, primarily, by the consideration of age, we subscribe to nothing of the kind. Since most music testing is done in schools with grade groups, grade norms make the interpretation of scores easier for the teacher to manage. There are other considerations which will be presented later — factors more important than age for their influence on scores.

Millions of American children terminate their formal education before they earn their high school diplomas. Only a small minority attend college. It should be enlightening to learn what this very select group of college students is able to earn on music tests. At New York and Long Island Universities, Manzer and Marowitz [99] measured five hundred young men and women in psychology classes with the K-D Music Tests. Their scores were higher than those earned by high school boys and girls. Accepting the score of 190 as average for high school, we find that these college men and women earned a mean score of 199.58. Their tendency to vary was quite similar to the sigma for high school populations. The lowest quartile earned 189, which is a little less than the average for high school children, while the upper quartile earned a score of 211, or 21 points above the average high school score.

To prove how effectively selection works, we need only examine the scores of music students on the college level to learn how much superior they are to non-music students of approximately the same age. These measurements are based upon 740 college music majors training to enter the profession of music after graduation. They represent Teachers College, Columbia University; Fine Arts College, Syracuse University; Juilliard School of Music, and some other eastern and midwestern colleges training teachers and performers in music. The Table below compares the scores, both individual and total, earned by music and non-music students of college age.

Test	*Music Mean*	*Non-Music Mean*
Tonal Memory	21.80	18.48
Quality Discrimination	25.60	23.51
Intensity Discrimination	23.76	23.66
Tonal Movement	26.93	19.04
Time Discrimination	20.53	18.86
Rhythm Discrimination	20.35	19.19
Pitch Discrimination	27.71	27.36
Melodic Taste	15.50	15.47
Pitch Imagery	21.04	15.35
Rhythm Imagery	21.75	18.66
Total	224.97	199.58

The college music student earns a higher mean than the non-music college student, but the scores of the music group are more homogeneous. When the critical ratio technique is applied to the two distributions, the ratio of 31 proves that this difference in scores may be expected 100 times in 100 and is not due to chance. It is well to remember that we find 4th, 5th, and 6th grade children earning 225 and better on this test and that it is reasonable to believe that these are, with reservations, the prospective music students in our universities and colleges. Although a small percentage of inferior students may enroll in music schools they are soon transferred to other departments or other schools or drop out of school because of the competition.

The correlation coefficient found for a population of seven hundred junior and senior high school students based upon chronological age and K-D Music Test scores was $-.56 \pm .02$. The younger children tend to earn the highest scores and the older children tend to earn the lower scores. This negative correlation is moderately high, containing a prediction accuracy of 17%. But the correlation coefficient tells only a part of the story. When we compare the scores and ages of the upper and lower 10% of the population we find that the difference in scores is roughly ten points but when we compare the difference in ages we find the two groups separated by an age difference of sixty-four months. In other words, the 10% of our population which is $5\frac{1}{3}$ years younger earns a score ten points more than our older group. Invariably, the younger group will be found to surpass the older one in music talent and musical accomplishment. If there are compensations for increased age, they are not to be found in our measurements. Undoubtedly, the attitude toward the benefits of age is much more charitable than scientific. Realizing that deficiencies exist, we engage in wishful thinking, hoping that they will be removed by the element of time. No, there is no compensation in time for lack of proficiency and while our thinking on the subject may be motivated by good wishes, it is deceptive and unrealistic.

With monotonous regularity writers comment on the greater difference *within* than *between* groups. This fact we do not deny. The small differences which are found when two groups are compared are quite trivial in the light of the momentous differences earned by poor and good students within a group, yet little is done with this information in present-day educational practice. The schools of our land still promote children by age, primarily, which results in the bright child being held back much more than the dull child. We accelerate the dull and retard the bright. Our schools are actually reversing the educational requirements of the two groups. Research has shown that the unfortunate tendency to promote on the basis of age places those of lower mentality in a grade far beyond their level of achievement, and the child of superior mentality far below his level of achievement. For example, at the age of ten, the former would still have difficulty with the work of the 3rd or 2nd grade, while the latter would still be superior with work of the 7th or 8th grade. Placing high and low mentalities in the same grade may simplify many problems for the administration but produces calamitous difficulties for the child. Neither the bright nor the dull child is properly placed and the social consequences are tremendous. Homogeneity in age does not reduce the cleavage, but on the contrary age increases it. In no field of endeavor is this fact more dramatically apparent. If we were only more concerned with talent and less with age, many needed reforms in education in general and music education in particular could be started.

As we have pointed out, our schools are operated on a grade basis requiring most children to spend a year in every grade. This method of administration may be more or less satisfactory for the so-called academic subjects, which present factual material to children, stratified on a grade-age basis. However, this method of administering factual education has been criticized severely by psychologists because it does not take into consideration the child's learning speed. If it is unsatisfactory for the teaching of academic subjects, can we imagine how much worse it is for the teaching of music, both a non-factual subject and one remotely related to intelligence and chronological age? The grade classification has practically nothing to do with music talent potential and achievement. If it is bad for general education, it is infinitely worse for music education. In every so-called grade there are multiple grades in music. In the fifth grade, for example, you will find superior music talents comparable to those in conservatories and colleges, and you will also find music talents so poor that the kindergarten classification would be most flattering. Yet, music educators ignore talent differences by stereotyping materials and procedures into something which they call "fifth grade music." This unrealistic simplification of music teaching in our schools antagonizes and sacrifices the talented child, forcing him to waste his musicianship on unrewarding musical activities.

6

Music Talent and Sex

A VISIT to any public school music class will reveal that boys are more apathetic toward music than girls. The "boy problem" is a serious educational problem in American schools, in spite of the fact that its existence has been rather generally ignored or denied. The influence of sex in music is felt both in and out of school, expressing itself in many conflicting ways. As consumers of music, women overwhelmingly outnumber men and on the creative side, the disproportion is reversed. As producers of music, men are in the minority on the amateur level, in both vocal and instrumental music making, but on the professional level this relationship is reversed. In our grade and high schools the girls outnumber the boys in availing themselves of the instruction offered. On the basis of sheer numbers, females are more likely to be associated with music and musical organizations than are males. There are many explanations for the disparity of numbers.

We have observed how much more impervious to musical beauty the schoolboy is; how he lags behind the girl in the mastery of musical notation; how self-consciousness and fear silence him during the voice mutation period; how society's attitude toward music as an activity for girls conditions his thinking and how society and the home have contributed to a sex dichotomy that encourages girls and discourages boys. The musical climate is not all that it could be for boys, so let us examine some of the causes that contribute to this dichotomy. A brief review of some literature in the field of psychology and experimental esthetics may be helpful.

Many writers have emphasized the role of sex in originating different forms of esthetic impulse. Santayana [147] finds in the sex impulse, the origin and drive for the appreciation of beauty. "When love lacks a specific object, when it does not yet understand itself, or when it is sacrificed to other interests, the stifled energy is sublimated in various ways — susceptibility to the beauties of nature being one conspicuous form of sublimation." A similar point of view has been expressed by Langfeld [84] who holds that esthetic appreciation may result from thwarting of any impulse or desire. "In the many and varied forms of art," Langfeld states, "each individual can find his particular refuge. The strong and the weak, the rich and the poor, the prude and the libertine, the prince and the peasant can all select that form of art in which he can best realize a harmonious adjustment of the conflicting impulses that tend to torture and distort the soul . . . . So long as the human race is stirred by conflicts just so long will art endure."

Describing the esthetic experience, Buermeyer [16] asserts that the appreciation of art offers a more satisfying refuge from thwarting desires than the daydream, since objects of art afford tangible actualities to satisfy sublimated desires. These writers believe that the appreciation of art is to a large extent sublimated desire, which is in line with the modern hypothesis which attributes art activity and response to escapism.

If the impetus to esthetic appreciation is to be found in the fact that it affords gratification as a substitute response of a compensatory nature, how is one to account for the greater frequency with which girls and women turn to activities of an esthetic nature? Lehman and Witty [93] provide us with a provisional explanation. Even among young children, girls are obliged to restrict their range of participation in various activities to a greater extent than are boys. Girls between the ages of eight and twenty-two engage in fewer activities than do boys of corresponding age. Moreover, girls seem to be restricted geographically in their play behavior, confining their play to the home or nearby environs. Boys, on the other hand, engage in a larger number of activities, enjoy greater freedom from supervision and geographic restrictions. Horseback riding, hunting, fishing, flying kites, football, baseball, etc., take the boys out of the home, while the girls play within or near the home. Since girls are supervised and protected more than are the boys, they appear to have a greater need for sublimating their desires.

This hypothesis, if granted, gives us a possible explanation of sex difference in esthetic activities. We need only expand it a bit to explain why men produce more in the field of art creatively than do women. There is much experimental evidence to show that women are more tolerant of thwarting than are men and, in addition, their reactions are less violent. Girls are able to endure situations in their play behavior which would prove unendurable to boys, because of the monotony involved. Thorndike,[177] employing data assembled by Pearson, maintains that only 38% of men reach the median of women in patience. In the many experiments with animals, Cannon [21] found that male cats were more restive and excited when fastened to a holder than females. When the circumstances are favorable, genuine artistic creation may favor the male merely because he is more restless when thwarted. The struggle to effect an adjustment may be greater in men and consequently lead to greater activity and achievement in artistic creation.

Regardless of their achievements in the creation of a high order of art, females are likely to be physiologically more advanced than are males during the formative periods of childhood and adolescence. The physiological retardation of the boys during early life may account for the differences which investigators have measured and linked with sex. Physiological rather than chronological age is directly correlated with stages of mental maturation. Baldwin [3] maintained that the physiologically more mature child has different attitudes, different emotions and different interests than the child who is physiologically younger though of the same chronological age. His experiments show that at each chronological age level, the physiologically accelerated boys and girls had a higher mental age than those of average or below average physiological age. The girls, when classified on this basis, show a higher mental age for a given chronological age than do boys, for the girls are older physiologically and advance faster than boys. They face problems of social adjustment earlier, on the average, than do boys, and experience moral and religious awakening before boys. With these accelerations, the girls get an earlier start and capitalize on their greater physiological maturity until the college level is reached.

While the difference linked with sex is considerable, physiologically and chronologically, the authenticity of these differences lies in the psychological attitudes which accompany them. Trailing the girls during the formative period, the boys quite naturally lose their confidence and interest in art activities. Sensing inferiority and failing to realize that the time differential will ultimately equalize the sexes, boys are more likely to withdraw from participation in the arts, in a state of mind bordering on defeat. This sense of inferiority inevitably takes its toll, but it would be false to attribute it entirely to the physiological causes alone, for the blame rests also on society's attitude toward the arts.

We live in an age of materialism. Parents know that art yields only a precarious living, being unremunerative even for some of those who are most gifted. The measure of a man's worth is all too often based upon his income and his material wealth. Parental guidance, motivated by worthy intentions which we do not question, encourages full participation for daughters but only limited participation for sons. Since the boy is the "bread winner" he must pursue a more lucrative profession. Although music history has been made by disobedient sons who have resisted parental authority and have chosen music as a career, daughters, by and large, have escaped this type of treatment, since their art interests are more avocational in nature.

As long as society's misgivings about art as a proper and paying profession remain what they are, our children will continue to reflect this attitude. It is probably due to this condition that college art and music teachers admit the superiority of the boys in their classes, due undoubtedly to more stringent selectivity, which decimates their numbers but improves their quality. Only the more determined and gifted boys advance to the college level in vocational art and music study.

Turning now to the measurement of musical aptitudes and achievements linked with sex, we must bear in mind much of the background material which has been presented. We must remember that boys are not only physiologically retarded as compared to girls, but reared psychologically in a musical climate that is relatively inclement. Certainly no attempt is being made to "explain away" the inferiority of boys in grades and high school, when averages are compared. It is an interesting fact to note that when American boys and girls are compared the superiority of the girls is firmly established. Measurements on 4,247 school children in grades four through twelve will be found in the following Table. Girls show superiority on seven of the ten tests. Boys earn higher scores than girls in time, intensity, and quality discrimination.

KWALWASSER-DYKEMA MUSIC TESTS
Scores by Sex

Test	*Sex*	*Mean*	*Sigma*	*Number*
Tonal Memory	Boy	15.69	2.88	2260
Tonal Memory	Girl	16.05	2.82	2530
Quality Discrimination	Boy	21.50	2.95	2306
Quality Discrimination	Girl	21.26	2.52	2496
Intensity Discrimination	Boy	21.25	2.78	2228
Intensity Discrimination	Girl	22.05	2.83	2465
Tonal Movement	Boy	17.10	4.84	2261
Tonal Movement	Girl	18.04	5.23	2408
Time Discrimination	Boy	17.71	3.00	2253
Time Discrimination	Girl	17.56	2.88	2535
Rhythm Discrimination	Boy	17.29	2.58	2255
Rhythm Discrimination	Girl	17.35	2.38	2466
Pitch Discrimination	Boy	25.83	4.50	2213
Pitch Discrimination	Girl	26.19	4.34	2397
Melodic Taste	Boy	13.18	2.57	2165
Melodic Taste	Girl	13.78	2.79	2477
Pitch Imagery	Boy	14.83	2.48	2200
Pitch Imagery	Girl	15.23	2.53	2444
Rhythm Imagery	Boy	16.72	3.07	2183
Rhythm Imagery	Girl	17.45	2.97	2462
Total Score	Boy	179.70	16.20	2039
Total Score	Girl	182.05	16.75	2208

In another study in which scores were compiled and compared by sex, 3,588 boys earned an average score of 179.05 on the K-D Music Tests. An average mean score of 181.25 was earned by 3,833 girls. The range of grades represented was from the 4th through the 12th grades and all testing was administered to grade groups which were made up of boys and girls. When the scores of 500 New York University students were grouped by sex and compared, the men, numbering 285, earned a mean score of 197.31, while the 218 women earned a score of 202.54 on the K-D Music Tests. Again the men were somewhat better in quality, intensity, and time discrimination; in addition, they earned a better score in pitch discrimination. The women were superior in rhythm, melodic taste, and significantly so in tonal memory, tonal movement, pitch imagery, and rhythm imagery. Total scores by sex for 700 junior high school boys and girls, reported by Wise,[187] show the girls ahead with a mean of 179.4 for 351 girls and 178.3 for 349 boys. The instrument of measurement was the K-D Music Tests and the school was the Roosevelt Junior High School of Syracuse, New York. Here the difference is quite negligible for the means are close.

Employing the Seashore Measures of Musical Talent, Peterson and Lanier [129] tested approximately four hundred State Teachers College students at Murfreesboro, Tennessee. Their results are similar to those already presented, although they are earned on a different instrument of measurement and with a different population. Males are found to be somewhat superior in intensity, time, and rhythm, and inferior in pitch, consonance, and memory. Farnsworth [33] gave two hundred Stanford University students, equally divided as to sex, the Seashore Measures and the Kwalwasser Melodic and Harmonic Sensitivity Tests. Again men were superior to women in intensity, time, and rhythm and inferior in pitch, consonance and memory. Women are superior to men in the sensitivity tests of melody and harmony.

The scores of approximately three hundred Negro students of the Agricultural and Industrial Normal College of Nashville on the Seashore Measures of Musical Talent show the men to be superior on all tests but one, the consonance test. They are much superior to the women in intensity, time, and rhythm; however, while ahead of the women in pitch and memory, they are not so outstanding. Using the harmonic and melodic sensitivity tests, Allen[1] tested one thousand white and one thousand Negro children of comparable age, and nearly equally divided as to sex. She found that scores earned by the white children show them to be superior to the Negroes in both tests, and the scores earned by girls are higher than those of boys. However, the differences between the sexes, while slight for the Negroes, is somewhat more for the whites.

In the European study reported in part earlier, we find that the sexes are equally successful, achieving comparable results on the K-D tests in Germany, Austria, and France; the boys are superior to the girls in Scotland and Russia, but the reverse is true in Austria and Czechoslovakia. In Ireland, Italy, and England the superiority of the girls is of large magnitude. The greatest difference between the sexes is found in the Hungarian scores, the boys earning better than twenty points more than the girls. The greatest difference favoring the girls is approximately fourteen points earned in both England and Italy. When the scores of the ten countries are combined and subsequently classified by sex, the girls earn a mean of 191.49 and the boys earn 191.06. When we compare the scores of a corresponding number of American boys and girls, we learn that approximately two points separate the sexes here and only one-half point abroad, but the American level for both sexes is almost ten points lower.

KWALWASSER-RUCH MUSICAL ACCOMPLISHMENT TEST

Scores by Sex

Grade	*Sex*	*Mean*	*Sigma*	*Number*
IV	Boys	65.22	27.95	319
	Girls	70.23	29.80	283
	Both	67.57	29.72	602
V	Boys	74.04	29.62	322
	Girls	85.88	35.78	336
	Both	80.08	33.89	658
VI	Boys	92.50	38.94	376
	Girls	109.70	40.52	370
	Both	101.03	40.31	746
VII	Boys	100.70	38.80	638
	Girls	123.70	43.52	584
	Both	111.70	42.73	1222
VIII	Boys	116.50	40.36	305
	Girls	145.80	40.55	302
	Both	131.08	43.01	607
High School	Boys	134.06	52.26	255
	Girls	171.10	45.84	272
	Both	153.17	52.46	527

Finally, let us examine the scores earned by boys and girls on the Kwalwasser-Ruch Musical Accomplishment Tests. The accompanying Table shows the accomplishment of 2,215 boys and 2,147 girls on a test which measures music learning. Observe that in the 4th grade the boys trail the girls by approximately five points, and this disadvantage is increased to approximately thirty-seven points in the high school. Going from the 4th grade to high school, the girls gain one hundred points and the boys but seventy points. This difference represents two grades in achievement, since the average difference between grades is approximately fifteen points per grade. Starting with a small advantage, the girls increase their lead steadily, leaving the boys far behind. It is clear that talent differences based on sex are relatively small, yet accomplishment score differences are considerable and sex-linked.

The disturbing problem of teaching mixed classes in our public schools with a single, rigid course of study based upon a mythical grade concept still remains. To show the bewildering conditions confronting the music teacher facing a group of forty boys and girls armed with a single program, which largely ignores differences in talent, sex, achievement, and outside training, let us enumerate just a few of the more perplexing difficulties.

Testing the average 8th grade music class, for example, our measurements show that the girls of the class will average better than two points more than the boys on the K-D Music Tests. This difference represents 1¾ years of greater musical maturity for the girls. The scores on the Kwalwasser-Ruch Musical Accomplishment Test prove that 8th grade girls are 29.3 points ahead of the boys, a difference of two grades. It is clear that the boys on the average must be doing only 6th grade work, and obviously the sex cleavage alone splits the class into two divisions two grades apart. But this disparity due to sex averages is only one of the problems.

When the standard deviations are examined, we find them to be the same for boys and girls, a value of forty points. This means that one-third of the girl population approximately will be found earning scores between the mean of 145 and 185; another third will earn scores between 145 and 105; while one-sixth of the girls will earn scores above 185 and one-sixth will earn scores below 105. If we analyze the boys' scores in the same manner, we see that one-third of the population earns between

116 and 156; another third earns between 116 and 76; while one-sixth of the scores will be found above 156 and one-sixth falls below 76.

We have indicated that the average difference linked with sex is just a trifle short of two grades. The average gain per grade on the Kwalwasser-Ruch Accomplishment Test is only fifteen points. So the separation between the upper sixth and the lower sixth of the population represents 5.3 grades for both sexes. Roughly, the upper sixth for girls will be doing advanced 10th-grade work and better; the lowest sixth will be doing early 5th-grade work or less. Since the boys start with the 6th-grade average, their poorest sixth will be doing early 3rd-grade work or less and their best sixth will be doing advanced 8th-grade work or better. Therefore the spread of grades represented by only one plus and minus standard deviation is from early 3rd grade to advanced 10th grade in the so-called 8th grade and this spread takes into consideration not the total but only two-thirds of the population.

What then is 8th-grade music? To the music teacher this is no rhetorical question. There are age, sex, training, talent, achievement, voice, intelligence, esthetic, social, and vocational variables that are all but ignored so that music may be administered on a basis that disturbs the school routine least. Sacrificing the child for smooth school operation is the established practice of our day.

7

Music Talent and Training

IT IS IN the category of the trained that we find the talented in music, but we must avoid the error in reasoning that would lead to the conclusion that talent is a product of training. It is more accurate to consider training a product of talent. When a survey of talent is made in any school system, invariably the trained group surpasses the untrained group, whether the tests measure talent or achievement. In the review of studies which we are about to make, the term *trained* may mean only one-half year of music instruction on the piano or on a band or orchestral instrument, received either individually or in class, beyond that offered in the regular vocal work of the grades. This minimum of one semester of special music instruction on an instrument may vary in different studies and for different grades, but it is always minimal, hardly ever exceeding two years of extra instruction.

In some studies the differentiation is based upon success or failure in music-reading and the categories are likely to be *good* and *poor*. In other studies, categories of *high* and *low* are used and usually refer to scores earned on a single test or a battery of tests. When test scores are unavailable, teachers' judgments based upon the child's musical performance in music-reading may be used initially, but are checked later by objective testing. In the many investigations which the author has conducted and supervised, the greatest difference found between groups is that yielded by this method of classification. Differences linked with age, grade, sex, intelligence and nationality, while not to be ignored, are mere trifles in contrast to differences linked with training.

When the K-D Music Tests were first issued and norms were being tentatively made, the scores of approximately 4,200 children ranging in age from ten to nineteen were regrouped by training and compared. In this initial investigation, children who had studied music outside of school for six months or more were classified as trained and children with less than six months of training were classified as untrained. Most of the children in the latter group had had no training beyond that given in the classroom, which was entirely notational and vocal. The comparison of scores is clearly shown in the accompanying Table. On every test the trained are superior to the untrained. The difference in total score is 11.25. If we convert this difference to an age difference, it represents about five years chronologically but, as we know, there is no age difference between the two groups under consideration. In many studies which have followed, we find that as we increase the period of training, arbitrarily drawn in the study just reported at six or more months, the trained group lifts its score on the K-D Music Tests, while the untrained group remains about the same. The reason for discussing the arbitrary nature of the line of demarcation is to show that the group, designated as trained, becomes more select and increases its superiority as we raise the training time.

KWALWASSER-DYKEMA MUSIC TESTS
Scores by Training

Test	*Training*	*Mean*	*Sigma*	*Number*
Tonal Memory	Trained	16.69	2.88	1780
Tonal Memory	Untrained	15.28	2.72	2666
Quality Discrimination	Trained	21.34	2.60	1844
Quality Discrimination	Untrained	20.46	2.80	2774
Intensity Discrimination	Trained	22.48	2.79	1792
Intensity Discrimination	Untrained	21.87	3.15	2715
Tonal Movement	Trained	18.93	5.61	1722
Tonal Movement	Untrained	16.53	4.68	2805
Time Discrimination	Trained	18.14	2.80	1770
Time Discrimination	Untrained	17.18	3.04	2661
Rhythm Discrimination	Trained	17.63	2.51	1754
Rhythm Discrimination	Untrained	17.01	2.51	2714
Pitch Discrimination	Trained	26.92	4.16	1756
Pitch Discrimination	Untrained	25.11	4.47	2729
Melodic Taste	Trained	13.81	2.70	1782
Melodic Taste	Untrained	13.15	2.90	2613
Pitch Imagery	Trained	15.49	2.62	1745
Pitch Imagery	Untrained	14.76	2.30	2677
Rhythm Imagery	Trained	18.44	2.57	1741
Rhythm Imagery	Untrained	16.39	2.97	2693
Total Score	Trained	187.50	17.20	1691
Total Score	Untrained	176.25	14.90	2513

Children in the public schools of South Bend, Terre Haute, Vigo County, St. Joseph County, Mishawaka, LaPorte and Whiting, all of Indiana State and Ridgeford, Illinois, were classified by their teachers as best singers and poor singers. The children were selected from grades four through nine. The best singers, numbering 1,088 and the poor singers, numbering 1,052 were chosen from 360 classes by approximately 200 grade school teachers. Only the three best and the three poorest singers were chosen to represent a class. Briggs [14] describes the best singers as those who could sing in tune, independently and more accurately than others in the class. The poorest singers were those who were classified as monotones; those who could not match tones or repeat, correctly, easy exercises in oral dictation; those who sang in tune only when others sang along with them but could not sing a familiar tune independently. When three musical deficients were not present in a room, the teacher reduced the number, but always matched the poorest ones with an equal number of the best ones. The distinction between the best and poorest rested simply on the child's ability or inability to sing in tune. The best and poorest were then given the K-D Music Tests. In most classrooms, all the children were tested but only those taking part in the investigation were used in the study. In taking the test, the children were not apprised of their classification by the teacher.

The total score, when averaged for all grades, was 168.0 for the 1,052 children in the poor classification. The average total score for all grades was 184.4 for the 1,088 children in the best singer classification. This difference in means is equal to twelve years chronologically, a difference of approximately twice the spread of years represented by grades four to nine, inclusive. The study also reveals that two-thirds of the best singers are girls and only one-third boys, but in the poorest singers, four-fifths are boys and only one-fifth are girls. This proportion of boys to girls in good and poor groups may vary some from one study to another, but the girls always outnumber the boys in the good groups and are outnumbered by the boys in the poor groups.

In an attempt to learn what part instrumental training played in the scores, an arbitrary reference point of ten lessons was drawn to regroup the population. Those who received less than ten lessons on an instrument were classified as untrained, and the others were classified as trained. Temporarily ignoring the designations of best and poorest, the entire population was reorganized and new means and standard deviations computed. The new grouping on the basis of ten instrumental lessons, resulted in 727 classified as trained and 1,413 classified as untrained. Of the 727 trained, 151 belonged to the poorest group and 576 were previously found in the best group. Of the 1,413 untrained non-instrumentalists, 901 were previously found in the poorest division and 512 in the best. Cutting across the old classifications and with training reduced to the low denominator of ten lessons, the following means and standard deviations should be most revealing.

KWALWASSER-DYKEMA MUSIC TESTS

Singers	*Mean*	*Sigma*	*Number*
Trained			
Best	194.85	16.60	576
Poor	175.60	14.15	151
Both	187.25	17.20	727
Untrained			
Best	177.15	17.30	512
Poor	166.70	14.60	901
Both	170.49	16.40	1413

Of the children designated as trained, nearly four-fifths are from the former classification of best singers. Of the children designated as untrained, only one-third come from the best singer classification. It is evident that not all of the best singers avail themselves of the opportunity of studying an instrument and yet it is heartening to find that 53% are doing so, whereas only 14% of the poorest singers study an instrument.

In a similar study, Lambert[83] measured 1,024 children from the intermediate grades of the elementary schools of Niagara Falls, New York. These children were selected by their own classroom teachers on the basis of their music-reading ability. Each 4th-, 5th- and 6th-grade teacher in the city was asked to select ten children, five of the best and five of the poorest sight-readers in her room. "The five that make the largest contribution, who carry the rest of the class along, and the five who make the smallest contribution to the class when new material is being sung" characterize the two groups. The pupils chosen represent one hundred three classrooms, in eighteen elementary schools. The Kuhlmann-Anderson Intelligence Tests and the Henmon-Nelson Tests of Mental Ability furnished the mental measurements, while the K-D Music Tests were used for music measurement. Age, sex and outside music training were also investigated. It was found that the good and poor music-readers earned 181.61 and 170.57, respectively, on the K-D Music Tests, which is a statistically significant difference between the two groups. Again, the intelligence scores of 106.65 for the good and 101.37 for the poor established a comparable tendency toward regression in intelligence. This difference is statistically significant, also. In months, the age means are 133.47 for the good and 135.40 for the poor group, and again the older pupils are the inferior ones. Of the good readers there are twice as many girls as boys, and of the poor readers there are twice as many boys as girls. Again, the correlation between intelligence and music scores for the population of 1,024 pupils is +.33 ±.03.

Ignoring the classifications of good and poor, roughly two and one-half points separate the boys and girls in intelligence but only one point separates the sexes in music. Half of the difference in intelligence scores then may be linked with sex but the sex variable is less than one-tenth the difference between the good and poor categories. Taking the 75th percentile as a point of reference, we find that 55% of the good group and only 22% of the poor group equals or exceeds that point. Only a small percentage of the children had any musical instruction outside the school, but in both categories those who were taking private lessons outside of school earned higher mean-scores on the music test. The score of 27½% studying an instrument in the good group was 189.54 and 10% of the poor group earned 178.3. The accompanying Table shows how the scores compare.

Group	*Good Readers*	*Number*
Trained	189.54	141
Untrained	178.58	371
Both	181.60	512
Group	*Poor Readers*	*Number*
Trained	178.30	50
Untrained	169.73	462
Both	170.57	512

When this study turned to the consideration of the one child who was best and the one child who was poorest in every room, the best average is 201.92 and the poorest 152.70 for one hundred three children in each category. There are forty-one boys and sixty-two girls in the best group and seventy-four boys and twenty-nine girls in the poorest group.

Reference has already been made to one of the pioneer studies of Larson [88] employing the six Seashore Measures of Musical Talent with elementary school instrumental classes, the junior high school preparatory groups and the junior high school advanced orchestra. He found a steady and significant increase in average percentile scores as follows: elementary instrumental classes 49.1, junior high school preparatory orchestra 52.1, junior high school advanced orchestra 66.0, senior high school advanced orchestra 73.2. The study led Larson to suggest that this significant advance in scores made it possible to select promising candidates for the orchestral ensembles on the basis of the Seashore Tests given to elementary school instrumental classes.

This was in line with Seashore's belief that, since there was no correlation between training and talent, gifted children could be discovered before they received training. Indeed, children can be measured for music talent before they receive any instruction whatever in music. Stratified as we are in music talent, training is merely, so to speak, an accessory after the fact. Those of inferior talents tend to drop out of instrumental and orchestral groups, leaving the superior ones to carry on. Unquestionably, the superior ones in the senior organizations were the superior ones in the junior organizations.

What we have found to be true about instrumentalists and their superiority over the rank and file of the untrained throughout the grades and high school, applies with only slightly diminishing weight to those enrolled in special choral groups in our schools. We compared the scores of two hundred junior high school orchestral players with those of two hundred glee club and choral singers, tested in Syracuse, North Syracuse, Manlius, all in central New York, and South Orange, New Jersey. The K-D Music Tests were used with the following results: the vocal group averaged 191.45 and the orchestral group averaged 194.54. The manual of directions for the tests shows that this difference in scores represents eight percentile points. With the median score for the junior high school population at approximately 181, the vocal group earns a percentile rating of seventy-five. It may be concluded that the vocal groups, while not as select as the orchestral groups, represent a level that is equalled or improved upon by only 25% of the school population.

In an effort to determine the relationship between hearing acuity and musicality, Weber[183] obtained measurements on 1,012 school children in Ithaca, New York, with the Western Electric Audiometer No. 4 A, and the K-D Music Tests. The children ranged in grades from five through nine. He found right-ear acuity superior to left-ear acuity for the entire population and girls superior to boys. The trained classification included 239 girls and 202 boys who had ten or more lessons on some musical instrument, either through the Instrumental Music Department of the school or from private instructors. Less than ten lessons placed the child in the untrained category, in which there were 295 girls and 276 boys. The music scores on the basis of training and sex are:

Group	*K–D Score*
Trained girls	195.26
Trained boys	194.92
Both	195.10
Untrained girls	184.04
Untrained boys	181.97
Both	182.97
All girls	189.15
All boys	187.89

The sex difference of 1¼ points is only about 10% of the difference linked with training. In commenting on the high scores earned by children in the Ithaca School System, Weber observed that a large proportion of the children come from homes of Cornell University and Ithaca College faculty members, or from homes where one or both parents were graduated from one of these schools or other colleges. He claims superiority for the average child in the school system and the scores on the tests support him amply.

In concluding this chapter, the author wishes to report a study under his supervision made by Lehman [92] which introduced a number of novel aspects. His population of 450 subjects was divided into two groups of 225 each, classified as continued and discontinued. In the former classification are subjects who have continued their instrumental training (at the time of the study) and were majors in music on the college level, practicing musicians, and established teachers of music. Included were one hundred thirteen males and one hundred twelve females. In the discontinued group, we have the same proportion in regard to sex and the subjects were all of college age or older. Roughly one hundred ninety subjects in each classification attended college at the time of the study. Inclusion in the discontinued group rested upon the fact that the subject had studied an instrument and for one reason or another had dropped it subsequently.

There are many important phases of the study that do not concern us at present but those that are relevant to this discussion support the contention that music test scores may be used prognostically for the selection of the musically superior. The outstanding difference between the two classifications was disclosed by the music test, with the continued group earning a mean of 228.48 and the discontinued group a score of 202.41. In intelligence, both groups were above the average as might be surmised from the fact that almost 85% of the membership was attending college. The continued group earned 112.41, and the discontinued group earned 110.13. When we compare the differences in intelligence and music in the light of their standard deviations, the magnitude of the difference in music is eight times as great as that in intelligence. Such a difference cannot be accounted for by chance, as may readily be observed if we compare the standard deviations of 8 for intelligence and 18 for music. The correlation coefficient between the music scores and the intelligence scores for the total population of 450 subjects was only +.18. Again, no accurate prediction is possible from intelligence to music or vice versa; nevertheless, the superiority of the continued classification is established.

Space does not permit the introduction of other aspects of this research project but one point must be stressed. This investigation was pursued on a vocational level. Those who constituted the continued class were either preparing for music as a career, attending college for professional training or performing as professional musicians and teachers. The scores which this group earned in music are comparable to those earned by the Fine Arts music students at Syracuse University and elsewhere. In computing norms for the professional musician, the value of 225 was established as the median percentile for the professional population. That level of competence is confirmed by this study, for vocationally-minded musicians earn a score roughly 25 points above non-musicians on the college level. Difficult as it is to isolate all of the considerations which condition musicianship, those that have been isolated and evaluated have vocational implications. The truth about training must now be apparent to all for if it is a factor that must be understood differently.

When the author pointed out some years ago that there may not be a one-to-one relationship between teaching and learning, many were disturbed by the generalization. However, it is a fact that teaching need not be accompanied by learning, nor learning by teaching. The first attempt to show regression in scores with increased teaching was made by Church [24] some twenty-five years ago with the aid of the Kwalwasser-Ruch Test of Musical Accomplishment on 4,177 children from grades four through twelve. In 1921 a standard course of study was compiled by the Research Council of the Music Supervisors National Conference and issued as Bulletin No. 2. The Bulletin was prepared for the purpose of assisting supervisors and school superintendents in planning their courses of study, as well as for the purpose of giving music a more stable and fixed position in the general curriculum. Shortly after this course of study for music appeared, Dr. Ruch and the author collaborated in building a test containing materials and skills outlined in the Bulletin. When the test was completed, members of the Research Council were asked to give it to the children in their school systems. When the test papers were returned the results were used to plot learning curves for boys and girls by grade, age, sex, intelligence, training and other considerations. Training produced the most disturbing results.

Some of the conclusions are: The acquisition of musical knowledge in the public schools is unsteady and irregular. Not only are plateaus found but, frequently, further teaching is accompanied by a loss in learning. Major key signatures are known only by a small percentage of pupils; minor key signatures are practically unknown. Rests are more difficult to master than notes. The skill of reading from notation is not acquired by grade-school children to any considerable extent. Children are unable to recognize songs by sight which they know by sound with any degree of proficiency. Girls are more than a grade in advance of the boys in musical accomplishment, throughout the entire range of grades. The acquisition of notational knowledge is so slow as to reflect discredit on the present status of music pedagogy. Strange as it may seem, the learning-rate expressed in test items per year is 1.08 for grades one to four and only half of that for grades four through twelve. The study proves that present teaching methods and materials are not sufficiently refined to insure the realization of many of the aims formulated by the National Research Council of the Music Supervisors Conference.

Almost thirty years later, another study was undertaken by Sauerwein [148] on a smaller population for the purpose of learning not only the relationship of teaching to learning but whether the intervening years had changed it. Both city and rural schools were represented by 1,650 children measured by the same accomplishment test. They came from Glen Falls, Ballast-on-Spa and rural school systems of Granville, Greenwich, Hartford, Mount Kisco — all of New York State. The conclusions drawn from the study are as follows: Pupils trained in instrumental music show more achievement than those trained only in general music classes. On the high school level, pupils trained in instrumental music show more achievement than those trained in choral music. Loss in notational knowledge acquired in some earlier grade and subsequently forgotten was shown for instrumental and non-instrumental groups on every grade level. Boys and girls fail to retain what they have learned in earlier grades. Test 10, "Recognition of Familiar Melodies from Notation," shows the least amount of retrogression, grade by grade. It is a more functional test which involves music-reading skill rather than notational knowledge. On the average 30 of the 125 items of which the test is constructed show a loss when measured in the grade higher, with the boys defaulting a little more than the girls.

When we attempt to summarize the results of the last two studies, we find that learning does not follow steadily the rule of accretion. While an over-all gain may be achieved, loss due to diminution of knowledge is considerable. Much that the child learns this year, he "unlearns" next year and some of this material resists relearning, being permanently forfeited. Teachers, naturally, take no pleasure in the discovery that what the child attains today may not be retained tomorrow. It's a disconcerting situation. We may attribute the loss in learning to various pupil-considerations, as many teachers are inclined to do, but poor teaching techniques must not be overlooked. The learning-front is a joint pupil-teacher responsibility. Gains which are subsequently wiped out by losses, threaten progress. Both the teacher and the pupil must be alerted.

8

Music Talent and Motor Measurement

WE HAVE LIMITED our investigation to the measurement of intelligence, age, sex and training, basing our report on the investigations employing standardized tests. We are now prepared to consider the results of other representative studies measuring motor response, in which standardized and other objective types of tests were used. We know that music may have a calming and quieting effect or a stimulating and energizing influence upon the listener. The recreational and therapeutic values of music involve nerve and muscle relaxation, stimulation and regeneration. In fact, the basis of the esthetic response may be predominantly visceral and muscular; involving heart, liver, intestines, stomach, smooth and striped muscles.

When we observe that two musical phrases are balanced, our judgment may be derived more from muscular tensions and relaxations that accompany the auditory experience, than from intellectual sources. Experimental esthetics and its study of heart, lungs and stomach during esthetic stimulation, reveal the importance of the viscera to esthetic experience. The studies to be reported in this and the following chapters show how much more meaningful, statistically, the motor response is to music than the mental. The measurements were made on large populations of college, high school and grade school students with a variety of motor tests. The results are thought-provoking.

Equilibrium may be defined as the ability to maintain the body by proper muscular forces under nervous control so that it can perform coordinated movements or resist the force of gravity. The "seat" of the sense of equilibrium, theory has it, is located in the semicircular canals, which are an extension of the hearing apparatus. But the eyes are also very definitely coordinated, for body sway increases about 50% for both children and adults when the eyes are closed. Some of our equilibrium measurements were obtained with the eyes of the subjects closed. Using a walking board, Long [96] found the deaf significantly inferior in the sense of balance. Some experimenters have shown that there is a slight tendency toward increase in steadiness with an increase in chronological age. Our investigations help to confirm this generalization but the age differential has not been very thoroughly explored in our studies.

The first study which attempted to measure equilibrium and correlate it with music test measurements was undertaken by Marketto [100] at Cannelton, Indiana, as a thesis project under the supervision of the author. The apparatus which he built consisted of a rotating table (adjustable as to height) upon which were mounted and centered large pieces of paper. A pencil rides the paper and moves when a wooden shaft, attached to the subject's body by straps, moves. The rotation of the table-top is controlled by motor and pulley wheels. Marketto tested 55 boys and girls between the ages of 10 and 17 with the aid of this machine, requiring each subject to stand for 15 seconds with eyes alternately closed and open. He then correlated these scores with those earned on the K-D

Music Tests, individually and collectively. The highest r he obtained was +.65 ±.05 for melodic taste and equilibrium and for the ten tests of the battery combined +.51 ±.07. These very satisfactory coefficients led him to believe that a closer relationship existed between the physical and esthetic responses than had generally been recognized. Since the melodic taste test called for discrimination based upon compatibility of phrase material, success in earning a good score, it seemed, rested partly on the possession of a good sense of equilibrium. There can be no denying the fact that many other values are also involved in esthetic judgment but the part played by bodily response was at least being measured and was yielding encouraging results.

A more extensive study of equilibrium and the K-D Music Tests on 268 subjects, present and former students from Van Etten and Spencer, New York, employing the same instrument and method of measurement used by Marketto, was launched by Olichney.[122] His subjects earned an r of +.62 ±.02 for total score on the music and equilibrium tests and an r of +.36 for melodic taste and equilibrium. An r of +.62 has a prediction accuracy of 8%, yet if groups taken from top and bottom positions on the curve are compared, those who earned high scores in equilibrium would tend to earn comparable scores in music. For the type of testing employed, the correlation must be considered rather satisfactory, since the equilibrium test measures something that is also measured by the music test and vice versa.

Our first college study compared the equilibrium scores of fifty Fine Arts music students and fifty non-music students at Syracuse University. Membership in the latter classification required non-participation in musical activities during the entire college career, up to the time of the test. No music tests were given to determine musicianship but it may be assumed that those in the Fine Arts group were vastly superior to the non-music group as has been demonstrated without exception in other investigations. The musicians earned better scores than the non-musicians, in equilibrium, whether the right or left foot was used.

One very dramatic difference between the two classifications overshadows the importance of the generalization just made. It appears that the difference between scores on the left- and right-foot measurements shows a much wider range for the non-musicians. There is little difference in scores between left and right foot for musicians but the difference is more than ten times as great for the non-musicians when left- and right-foot scores are compared. A condition similar to ambidexterity applies to this accomplishment, for the musicians seem to have two "right" feet as their scores indicate. When all the scores are combined by sex, the boys are superior to the girls and their scores fluctuate less.

A 12-inch length of iron railroad track was part of the equipment used in a balancing test with 584 high school and college students by Lavere.[89] Half of the trials were accompanied by "Roses from the South," a Johann Strauss waltz, recorded by the Pittsburgh Symphony Orchestra, under Fritz Reiner. Each subject was instructed to balance himself on the rail with the other foot free from the floor and the rail. Once his balance was secured, the subject was asked to close his eyes at which point the timing began. When the state of balance was lost, the timing was stopped and the score recorded in seconds. Then the test was repeated a second time with all conditions rigorously maintained and with the addition of the musical accompaniment. In half the cases the order was reversed, with the accompaniment being used during the first measurements. Obviously, the reversal was employed for the purpose of eliminating the practice factor in the test; however, ample practice opportunity was given every subject before the testing commenced. Of the total population 245 had had musical training and their scores were grouped together as were the scores of the 339 untrained subjects.

When the balancing scores were compared, it was clear that the accompaniment of music had improved all of them, but the improvement of the musically trained was twice that of the untrained. Music added $1\frac{1}{2}$ seconds to the scores of the untrained, on the average, and 3 seconds to the scores of the trained. Strangely enough, the two groups differed by only a small fraction of a second when unaccompanied by music. The untrained girls improved the least by the addition of the accompaniment, while the trained men improved the most; and the highest scores for the entire population were earned by those who were preparing to enter the field of music professionally. This statement holds good for both the accompanied and unaccompanied scores.

Closely related to equilibrium is the study of Harding,[57] the first to be concerned with the relationship of muscular control of arms, legs and body with musical judgment. Many investigations in the field of social science, dealing with the relationship between the physical and mental traits generated both "heat" and "light" in the years at the turn of the century. Galton [38] had repudiated his earlier claim that poor students, poor in scholarship, were likewise weak physically. Resorting to measurement, he subsequently showed that success in literary examinations of 20,000 Cambridge students was in no manner connected with stature, weight, strength or breathing capacity. A great number of studies followed. Some of them show very low positive relationship and others very low negative relationship. When the age variable is eliminated, the results approach zero, for predictive purposes.

Gates [44] reports an r of +.06 between height and mental age on the Stanford-Binet and an r of +.10 between weight and the Stanford-Binet. In a study of 221 Columbia College freshmen, Garrett and Kellog [40] found a low correlation between height-weight ratio and social intelligence. Murdoch and Sullivan [112] measured 597 children in Honolulu for height and intelligence and report an r of +.14. Pearson and Moul [127] made an elaborate biometrical study of 616 alien Jewish boys and 580 alien Jewish girls residing in London and found a negligible correlation between estimated intelligence and height and weight. With these and numerous other studies indicating practically no relationship between the physical and the mental, our first music study [57] was, we thought, off to a most unpromising start, but then we need not remind the reader that we are not dealing with intelligence.

The apparatus used in measuring muscular response consisted of a wooden frame with slotted vertical bars 84 inches high and 4 inches square, fixed at right angles to the floor. Between these were movable horizontal bars 60 inches long and 4 inches square. Two small adjustable wooden blocks were attached at right angles to the horizontal bar. With this instrument 459 subjects were tested: 235 boys and girls of the Lawrence H. Van den Berg School of Practice of New Paltz, New York and 224 men and women at the State Normal School of New Paltz. Lateral erectness of the body was measured, using the apparatus and a plumb line. Deviations from absolute erectness toward the right were recorded as positive; deviations toward the left were recorded as negative measurements. Measurements on arm-raising, knee-raising and forward-bending were accurately made. The subject was assisted by the experimenter to get the "feel" of the position that was accurately erect, then without aid to assume this position. The error in accuracy is the score for erectness. The tests measuring musical response were the Schoen[150] test of tonal sequence, and four K-D Music Tests: tonal memory, tonal movement, rhythm discrimination, and melodic taste.

The results of the tests showed that elementary school boys and girls are superior to the normal school men and women in erectness of body and males are superior to females. Adults tend very definitely to lean toward the right. Height and age are negatively related factors in control of the muscular traits under measurement but the untrained were somewhat taller than the musically trained. Again females earned a higher composite musical score than did men and the trained were significantly superior to the untrained.

But the most gratifying result of the study came from the correlations between muscular and musical scores. In earlier chapters we learned that intelligence and music tests correlate in the neighborhood of +.33. We also know that many music educators claim intellectual prowess for those who receive music education. But it appears that they have overlooked an even better bet in failing to claim physical prowess as a reward for music study. The correlation coefficient is +.77 for men and +.56 for girls, but only +.21 for women between composite musical and composite muscular scores. For the entire population the coefficient is +.48 ±.03, which is better than 50% more prediction accuracy than the correlation between music scores and intelligence scores. Body erectness correlates +.42 ±.02 with composite music score.

Our theory, associating muscular with musical experience has some statistical support from this and other studies. From the standpoint of psychology, memory has long been linked with kinesthetic reactions. Thinking defined as sub-vocal speech by Watson[181] is an example of this school of thought. It is likely that in memorizing a tune we acquire muscular configurations that aid us with retention and reproduction.

Comparing 126 boys and girls earning the highest scores on the K-D Music Tests and 126 boys and girls earning the lowest scores in the Junior and Senior High Schools of Ridgeway, Pennsylvania, Stephens[166] applied the MacQuarrie Test[98] for Mechanical Ability and a motor precision test. The MacQuarrie Test, which may be given to groups of subjects simultaneously, measures tracing, tapping, dotting, copying, locating, pursuit and spatial perception. The motor precision test consists of an electrified metal plate perforated by holes of various sizes and a metal pointer which makes contacts when the plate is touched. A buzzer warns the subject each time he fails to make a "bull's eye" and an automatic counter adds up the number of contacts or failures.

On the music tests the high and low groups were separated by forty points, which is statistically significant. Also significant is the superiority of the high music group in the precision test which reveals them as superior in precision for the right hand especially and to a lesser degree for the left hand. In both right- and left-hand precision measurements it is evident that their scores support the idea of two "right" hands. Just as we learned from equilibrium measurements, in which the musicians were superior whether they stood on the right or left foot, so the musicians earn superior scores whether they aim with the stylus in the right or the left hand.

Just as two groups are widely divergent in their music scores they are likewise differentiated in their mechanical ability scores. The best 126 boys and girls in music earn a score of 196.11 and the poorest 126 earn a score of 178.21

on the MacQuarrie Test. Since no coefficient of correlation between the two types of tests was computed, it is not possible to report what the accuracy of prediction is when the music score is used to anticipate the mechanical ability score. It is likely that an r of fair size is present.

At Onondaga Valley Academy, Syracuse, New York, 200 children were divided into trained and untrained groups by Hills.[63] The line of demarcation was drawn between the two classifications when six months of instruction on an instrument had been received. Of the 200 children of the 7th and 8th grades, 70 were trained and 130 untrained. All were given the K-D Music Tests, which indicated that they were approximately 10 points apart. Then they were given the Purdue Pegboard Test,* which measures the subject's ability to perform manipulative operations. This test is used widely by industry to help with the selection of the more dextrous employees. It provides separate measurements of the right hand, left hand, and both hands together and measures dexterity of two types: (1) involving gross movements of hand, fingers and arms, (2) involving primarily what might be called "tip of the finger" dexterity needed in small assembly work.

When we analyze the scores earned by the two groups, we discover that the difference in music scores is equalled and at times surpassed by the manipulative scores. The critical ratio technique, which helps us to interpret the magnitude of difference, proves the statement to be true. In the music test, the ratio between the trained and the untrained is 5.47; for the Pegboard and left hand, it is 5.16; for the right hand, it is 3.65; and for assembly it is 7.17. These critical ratios are high, indicating that there is no likelihood that this difference is due to chance.†

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* Purdue Pegboard, published by the Science Research Associates, Chicago, Illinois.

† Any value above 3 is statistically significant.

Again we learn that the best in music are likewise the best in manipulative skills. Also, that the left hand of the trained, while not superior to the right hand of the untrained, approaches the right-hand measurements of the untrained. It is in assembly that the trained excel, which is an obvious requirement for instrumentalists. The enormous difference in assembly scores may partially explain why our non-instrumentalists do not avail themselves of the opportunity to study an instrument.

A similar study was made with five hundred boys and girls by Kiesz [74] at West Winfield, New York. Employing the Seashore Measures,* she compared the highest 25% and the lowest 25% in music with their achievement on a motility test, a steadiness test and an equilibrium test, accompanied by a waltz, a march, or unaccompanied. When we recall that the Seashore scores do not correlate with themselves or with intelligence much above zero, it is interesting to learn that this study shows a coefficient of correlation between the right-hand tapping scores (motility test) and the average percentile scores on the Seashore Measures of +.36 ±.04.

Using critical ratios for comparison, we find that the high 25% are significantly superior to the low 25% in speed of tapping and in all of the equilibrium measurements, especially when the march accompanies the test. The high 25% are also superior in steadiness, although here the advantage of the more musical group is reduced somewhat. While the boys are superior to the girls in tapping speed and in the equilibrium tests, the girls are superior to the boys in the steadiness test. We called the attention of the reader to the fact that in the steadiness test the advantage was earned by the top 25% but that it was somewhat less than that shown by the other scores. However, it is still large, for the critical ratio is

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* Revised by Seashore, Lewis and Saetveit. R. C. A., Camden, N. J.

2.56, which means that the chances are 95 in 100 that the difference is a true difference and not the result of chance. Music psychologists and vocational guides may be encouraged to add tests of steadiness and tapping speed to their inventories, since it is becoming increasingly more apparent that these traits distinguish the good and poor almost as much as the auditory measures do.

Continuing with our review of motor dexterity and music studies, one of the most recent was completed at Manlius, New York, by Radley.[135] She used the author's new short music talent test,* which can be administered in ten minutes, and the Purdue Pegboard test on 550 children. Using the short music test to segregate the best and poorest 6% of the population, the manual dexterity test was then given to these segments of the total population. The short music test, which was being used experimentally for the first time, consists of 50 items recorded on a 10-inch disc. The traits measured are pitch discrimination, time discrimination, intensity discrimination, rhythm discrimination and, indirectly, memory. The results, showing critical ratios as well as means, are:

Test	*Group*	*Mean*	*Critical Ratio*
Short Music Test	high	39.25	30.67
	low	25.60	
Short Music Test	girls	33.59	2.86
	boys	31.03	
Purdue Pegboard Right-hand	high	15.80	6.18
	low	14.50	
Purdue Left-hand	high	14.96	4.23
	low	14.11	
Purdue Assembly	high	34.00	7.30
	low	29.82	

Even the lowest critical ratio has only a 3% chance possibility and all the rest have no likelihood of chance entering into the difference statistically. The results are quite gratifying. Again it is true that the best 6% have better left-hand motor dexterity than the right hands of the poorest 6% and in a hand-to-hand assignment, such as assembly, they put their two good hands together to outclass their schoolmates. The correlation coefficient between music and assembly scores is +.43 ±.04. The highest r which we have yet found between intelligence and music, +.51 ±.04, was computed with this short music talent test and the New California Short-Form Test of Mental Maturity.* It is not surprising then to find the high music group earning a score of 113.28 in intelligence and the low group earning only 98.35. Obviously, something measured by the New California Test is also measured by the short music talent test since the overlapping is 14%.

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* See footnote on page 154.

Recapitulating, a prediction of intelligence from this particular intelligence test to this particular music test or vice versa is likely to be right 14 times in 100. This coefficient is higher than that usually found and only time will tell whether it is due to the population sampling, the new music test or the new California Mental Maturity test. Only one other correlation coefficient is available, at present, between scores earned on the new short music talent test and intelligence. Based on 148 cases, it yielded the familiar +.33, which has been established by the longer K-D Music Test scores, time and time again.

The MacQuarrie Test for Mechanical Ability is a paper and pencil performance test consisting of seven parts. It measures responses requiring tracing, tapping, dotting, copying, locating space relations, counting blocks and pursuit. With the MacQuarrie and the K-D Tests, Hickey[60] measured boys and girls in grades six through nine. Those who had any instrumental training were designated as trained, the others as untrained. Scores earned under these designations show that the trained with a percentile average of 71.8 on the music test are approximately 13 percentile points above the untrained. On the MacQuarrie Tests the trained earn a mean score of 57.9 and the untrained a mean score of 48.2. The differences in scores on the mechanical ability tests are even more divergent for the two groups than are the music scores and the correlation coefficient between the two scores is +.47. So it may be said that the music test measures, in part, functions that are measured by the mechanical ability test. Otherwise there would not be as much overlapping. Such an r still contains approximately 85% error when used for predictive purposes but it does contain 15% accuracy. The differences attached to scores classified by sex were quite small as compared with those yielded by training.

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* Published by the California Test Bureau, Los Angeles.

The complete MacQuarrie Test was given to ninety music students of Fine Arts College, Syracuse University, and fifty music and non-music pupils of Penn High School, Greenville, Pennsylvania, by Smith.[159] All students tested were right-handed. In every test the music group was superior to the non-music group, as may be seen from the following:

Test	*High School Music Mean*	*High School Non-Music Mean*	*College Fine Arts Mean*
Tracing Right-Hand	40.56	34.80	43.23
Tracing Left-Hand	35.84	34.56	41.58
Tapping Right-Hand	46.00	39.52	48.48
Tapping Left-Hand	35.52	32.72	39.24
Dotting Right-Hand	26.56	25.08	25.45
Dotting Left-Hand	20.36	14.36	16.75
Total Score	72.16	61.12	74.48

With the exception of the dotting test, the ninety music students on the college level are superior to the high school music students in all measures.

The study now to be reported, unlike the preceding ones, attempts to deal with the problem of how instrumentalists, grouped by choirs mostly, compare when given tests of motor adjustment. It is assumed that a possible relationship between handedness and performance on musical instruments could be shown by testing those who have achieved some proficiency on their instruments. Furthermore, if these traits follow a pattern that is unique, it might be reasoned that the pattern played some part in achievement of success in playing an instrument. Although a group of 55 non-instrumentalists were also tested, the study concerns itself chiefly with instrumentalists.

Junior and senior high school instrumentalists in Onondaga County, New York, and musicians at Syracuse University were tested individually with the Purdue Pegboard Test and a precision of movement test. Approximately 275 subjects were tested; 55 non-instrumentalists, 41 string players, 54 pianists, 48 woodwind players, 58 brass, 12 percussion and 6 French Horn players. The violinists and pianists earned the highest pegboard scores for both the right and left hands. The excellence of the string players in both right- and left-hand precision of movement scores is shown by their superior accomplishment. Ling,[95] whose study we are presenting, is very careful to avoid unqualified generalizations, realizing that the study has limitations. He draws the following conclusions: Handedness is probably determined, whether by inheritance or social conditioning, long before the average person begins his study of a musical instrument; string players evidence the most highly developed dexterity for both hands; females possess greater dexterity than males and instrumentalists are more right-handed than those with no instrumental training.

We wish to examine only a few of the findings by Gilbert [48] in a study of one thousand secondary school instrumentalists, equally divided in numbers as to sex and grouped by instrumental choirs. The investigation uses a number of diagnostic and prognostic tests and is the first to measure physical fitness with an instrument devised by Rogers.[141] In addition, intelligence, music test scores, length of time studied, teachers' rating and other data were assembled. Physical fitness is the capacity to perform physical activities efficiently and repeatedly without undue fatigue. It refers primarily to the strength, skill and endurance of the voluntary muscles. It is more than the ability to work or play. It conditions readiness which plays so important a part in the learning process.

Group	*Music Mean*	*Intelligence Mean*
1 Strings	80.2	110.35
2 Woodwind	78.95	109.51
3 Piano and Harp	68.55	107.1
4 Brass	66.8	105.6
5 Percussion	53.0	102.6

Gilbert found the violinists to be the youngest in age, the shortest and the smallest in mean lung capacity. The players of the tuba and Sousaphone, the largest brass instruments, are the tallest, heaviest and have the greatest mean lung capacity. In general, the brass players are the oldest, the heaviest and have the greatest mean lung capacity. The fact that girls have significantly inferior lung capacity than boys may account partially for the fact that more boys than girls play wind instruments. The physical fitness index conclusively establishes the boys' superiority over the girls'. The girls start their music study sooner, study longer and earn higher scores in intelligence and musicianship. The instrumental choirs rank in the same order on both the K-D Music Tests and the Otis Intelligence Test as the Table shows.

The music scores are given in terms of percentiles. The opinion of many in the field of music education, required to give vocational guidance without the aid of measurement, would probably fall in line with the above. String players are likely to be the most sensitive musically and percussion players the least. The position of the pianists is the one most likely to shift and the direction is likely to be upward. Assigning school-owned instruments to the most promising children is far from satisfactory at the present time, since scientific surveys of musical potential have not been made in many school systems. Therefore, the trial and error method prevails, which is costly and inefficient.

Why does one select a particular instrument and reject another? This question may never be adequately answered but many attempts to do so have been both informative and entertaining. Redfield's [137] attempt to answer the question is thought-provoking.

> "Why construct a machine to produce musical tones when everyone has a musical instrument given to him by nature — his voice? As a matter of fact, not every person has a satisfactory voice; some voices are naturally so poor that but little improvement could be effected in them no matter what amount of time and attention should be given to voice study. Again, some people do not have the kind of a voice they want. In his boyhood, the writer knew a tuba player who weighed about 105 pounds. He was the best musician in the band and the leader of the organization; but the only part he would play in the band was basso profundo. Nor was his an isolated case of a person wanting a voice different from the one given him by

nature. Many male musicians cannot be happy in the orchestra unless they are able to sing altissima melodies, and warble like a coloratura soprano; so they choose the flute or the violin as the instrument for them. Other men covet low tones of the contralto and will be satisfied with no instrument except clarinet.

"All music in the final analysis is singing; or at least, singing and dancing. We construct musical instruments to furnish us with an artificial voice when we have no natural voice, to supply us with a more powerful voice when our voice is weak, or to provide us with a voice more to our liking in compass or tone color. And with these artificial voices we sing in a manner such as our natural voices would never permit. Or, if our feet are too clumsy to dance as we would like, we become percussion players and dance to our hearts' content with sticks on our drum heads."

No one can deny that this bit of speculation is interesting and novel. It must not be accepted without qualifications, for we know there must be factors other than weight, motion, and size working in a compensatory manner in the choice of an instrument. In Gilbert's [48] study, the larger instruments are played by the larger children and the smaller instruments by the smaller children. Whether like or unlike forces attract each other is not as easy to formulate in music as it is in electricity, for example. The compensatory nature of art activity is well understood by estheticians, yet this aspect of art has not been abundantly explored; nevertheless, we are well aware of its existence and its impact.

The Lehman [92] study employed the Minnesota Multiphasic Personality Inventory, one section of which deals with Male-Female Interests in terms of overt or repressed sexual inversion, homosexuality and other types of drives in the direction of the opposite sex. He reports that the "male musicians of the continued group reveal stronger feminine interest patterns than the male non-musicians of the discontinued group. Likewise the female musicians revealed stronger masculine interests than females in the non-musicians group. In both cases the scores approach abnormality." The continued group consisted of approximately two hundred advanced college music students and adult musicians. The discontinued group consisted of two hundred college students who studied music for a time and later discontinued. This is probably the only experimental evidence to appear in the literature on the subject and it does lend some support to the theory formulated by Redfield years earlier.

With a population of 253 children, 116 having no instrumental training, Graf[53] measured steadiness and tapping speed. Her subjects represent grades six through twelve in the schools of Lyons, New York. Again the tapping scores of the instrumentalists, both for boys and girls, are considerably higher for weak and strong hands than those for non-instrumentalists. It seems that the difference in scores on the tapping test between girls and boys in the non-instrumental group is much greater than the difference in scores between the girls and boys in the band-playing group, indicating that the girls' scores in the latter group resemble the boys' scores more than they do the girls' scores in the non-instrumental group. These results give additional evidence of support to those who contend that inverted standards of achievement in the direction of the opposite sex may be present in musicians. Nevertheless, it will require considerable research to confirm.

Contrary to public opinion, the fingers of pianists were found to be shorter than those of non-pianists when shadow-graph measurements were compared. Both the left- and right-hand fingers were found to be smaller. In weight the pianists were 6½ pounds lighter than the paired experimental group, and 2 inches shorter in height. In the grip test the pianists averaged 71 pounds for the right hand and 67 pounds for the left hand, as measured by the manometer, while the non-pianists measured 89 and 85 respectively. Although the study is based upon a limited number of subjects, the two groups were carefully equated before measurement began.

Focusing upon speed as one criterion of success in piano playing, Henderson [59] studied trill-speed to learn (1) whether it is related to any of several physical characteristics of the performer and (2) whether the physical characteristics of the pianist are linked with the techniques by which he achieves speed. Such traits as sex, age, experience, length of fingers, hand volume, wrist motility, reaction time, and steadiness were measured. For each pianist, data were recorded regarding the eight physical factors and trill-speeds executed on adjacent white keys on the test piano keyboard. The pianists who took part in the study were Oberlin Conservatory piano students numbering 142 — 86 females and 56 males. They ranged in age from 16 to 30 years and averaged 19½ years, with an average of 11 years of piano training. All measurements were made with the aid of scientific instruments, electrically designed and controlled.

Henderson found that men played faster than women in each of the twenty trill trials with the 2–3 fingering showing greater speed than the 1–3. However, it was also shown that the greater speed was achieved by the fingering for which the pianist showed a spontaneous preference. Soft (*pp*) trills and trills played with flat fingers were relatively slow. For the 1–3 trill, a slight acceleration in speed was achieved by the use of forearm rotation. The physical characteristics of the pianist were analyzed in two ways: (1) as independent characteristics; (2) as they related to trill performance. Men earned higher scores than women in tests of motility and reaction time. In the test of steadiness, however, the women were superior. Positive relationships were found between motility and average trill-speed and between length of training and average trill-speed. For men only, there was a negative relationship between hand-volume (measured by the amount of water displaced in a beaker) and the average trill-speed, suggesting that lesser speed is achieved by the larger hand. To those with longer fingers, wrist rotation compensates for the slower trill-rate.

Before concluding this chapter, a few observations seem apropos. While there appears to be very little relationship between physical measurements and intelligence scores, we find on the contrary that physical measurements and music scores correlate quite well. The superiority of the musically trained and talented in the sense of equilibrium has been fairly well established. Superior achievement in both left- and right-foot scores reveals a trait comparable to ambidexterity for the more musical and greater precision scores for both hands. The musical are superior in the pegboard scores for both hands and for assembly. They earn higher scores in mechanical ability, in spite of the fact — or can it be because of the fact? — that they are shorter, lighter and less athletic than the non-musical.

Just how important are size, strength, weight and lung capacity in the selection of an instrument and its successful performance subsequently? In time, music psychology will have the answers. Gilbert's report on violinists as "the youngest, shortest and smallest in mean lung capacity" of the five groups measured may merely be a confirmation of what we so frequently observe when we see and hear violin virtuosi play. As a group, they tend to be sub-average in height, coming as they do from Latin and Jewish stock mostly. With shorter legs and arms, short fingers characterize the violinist. Henderson's study proves that the shorter fingers of male pianists produces speedier trills and although he did not study the speed of scale playing, it is quite likely that small, short fingers are similarly advantageous. So we must add to the speculative notion of the wide range of emotional experience and susceptibility of the Italian and Jewish temperament, which finds the violin the most serviceable instrument of expression, the scientific fact that measurement in the physiological field links speed of playing with shortness of finger and smallness of hand. In presenting this material we are not detracting from the emotional but adding a value that has heretofore gone undetected, generally.

9

Tongue-agility and Other Motor Studies

THE ABILITY to tongue rapidly is obviously but one of many factors to be taken into consideration when assigning a wind instrument to a beginner. Nevertheless it is one of the more important considerations conditioning performance proficiency. Until the past few years teachers of wind instruments have had no means of measuring tongue-speed and were obliged to resort to the costly trial and error method. Accurate prognosis was impossible. With school-owned instruments it is doubly important that instruments be properly assigned. The wrong assignment means waste in time and energy on the part of the learner as well as the loss of the instrument in band and orchestra ensembles. The trial and error method of distributing instruments is unfortunate for a biased attitude toward music on the part of the child may be linked with frustration.

Is tongue-agility, the speed with which the tongue repeats a syllable such as "tu" or "du" in a fixed period of time, innate or acquired? Do girls have speedier tongue-action than boys? Do age and nationality scores correlate with tongue-speed? Are intelligence and tongue-length factors of influence? How are music test and tongue-agility scores related? These questions and many more present themselves to the inquiring mind. The attempt to supply answers, not by speculation but by scientific measurement, will be the purpose of this chapter.

To begin with, the music educator could turn to the measurement of motility or tapping speed and learn what had been discovered in regard to finger and hand action. Most psychology laboratories are equipped with motility measuring instruments and a considerable body of knowledge, since tapping tests have had a long experimental history. A variety of methods of procedure and instruments of measurement have come down to us. One series of tests, for example, deals with the effects of caffein,[64] another with the effects of alcohol, another with the effects of diet, and still others with the effects of humidity, loss of sleep, dental treatment on school children, the most effective working period of the day, etc. The tapping instruments have taken many forms, too. The telegraph key has been used by some; the tapping board and stylus; pencil dots on paper; electrified plate and stylus, microphone, etc.

One of the early tapping tests was devised by Ream.[136] It consisted of a telegraph key, two batteries, a metronome with mercury cup, a counter and a shunt-key. The metronome measures the time intervals of the test; the counter records the number of taps made during the prescribed time interval; and the shunt-key, thrown back when the test begins and ends, insures greater timing accuracy. With this instrument and others like it, measurements of motility are easily and accurately accomplished. University of Iowa sophomores ranged in tapping speed during a 5-second time limit from 4.2 per second to 12 per second. As regards sex differences, investigators are practically unanimous in the conclusion that men are faster than women and that boys excel girls. In addition the female shows greater variability than does the male.

The amount of gain by practice is very small as a 20-day practice experiment proved and the gain is in regularity of performance rather than in increased speed, according to many researchers. There is a very slight increase with age before adolescence, but a slight recession during the years of puberty. Most experimenters believe that the increase in motor power due to age is trivial for the individual, when compared with the wide range of differences at every age level. Where the average individual might gain as much as 30% in 10 or 11 years, there are others at his age level as much as 250% better.

With this background of measurement in motility, the author launched the first experiments in the measurement of tongue-agility. The instrument first employed was the RCA recording machine which cut a record of the repeated syllable "du" for a fixed period of time, three or five seconds, usually. After the recording was made, it was played back at a greatly reduced speed which made it possible to count the number of repetitions under more favorable conditions. That this method of recording and counting the sounds was crude, costly and laborious, goes without saying. However, there can be no questioning its accuracy. With this machine and method of procedure, the pioneer study on tongue-agility was launched in 1948 by Buffan.[17]

From grades 4 through 12, 500 children of the Perry Public Schools, Perry, New York, were given the K-D Music Tests. Then the lowest and highest scores earned by the top and bottom 25% of the population were subsequently tested for tapping-speed and tongue-agility. After the highest and lowest quartiles were determined, it was found that 83 of the 125 top-ranking pupils had received 6 or more months of instrumental training. Only 5 of the lowest 125 pupils had received comparable training. The division in the music test is paralleled by the measurements on all of the other tests. The upper quartile earned a tapping score of 93.5, the lower quartile earned an average of 79.3. In tonguing the two groups were separated by scores of 102 and 86.6 for single-tonguing and 47.5 and 39.8 in double-tonguing. A correlation of +.78 shows the relationship between single and double-tonguing. If these measurements have any importance it is because they show such differentiation. The best quartile in music is the best also in tapping and tongue-agility. The poorest quartile in music is likewise inferior in tapping and tongue-agility.

These results encouraged the author to further research, but a more efficient instrument was needed and built. The author is indebted to William Bishop[11] and Russell Harris for their valuable assistance in this project. A complete description of the machine is not required but it consists of a microphone and audio-amplifier equipped with a counting mechanism operated electronically, which made reading of impulses automatic. Bishop then proceeded to measure individual differences of 10- and 13-year-old boys and girls of German and Italian parentage in tongue-agility, thus launching the first study of nationality and tongue-agility. Approximately 1,100 children were tested and compared by nationality, sex and age with the following results:

Nationality	*Sex*	*Age*	*Mean*
Italian	Boys	13	18.94
Italian	Girls	13	18.74
Italian	Girls	10	16.14
Italian	Boys	10	15.46
German	Boys	13	15.44
German	Girls	13	13.83
German	Boys	10	13.11
German	Girls	10	12.20

The means show how many times the "tu" sound was repeated in the microphone in a 3-second interval. Notice that age in itself is no criterion of speed, since the 13-year-old German is slower than the 10-year-old Italian child. However, within the national classification, age is a factor increasing scores somewhat. Observe also that German boys are superior to girls on both age levels, whereas Italian boys overtake the girls on the 13-year-old level.

Three tongue-agility studies were made the following year. The Ball [5] study compared the tongue-agility of 900 children in junior and senior high schools of Syracuse and Frankfort, New York, with the K-D Music Tests and a variety of intelligence tests. The scores for the 430 girls on the 3 tests compared with those of the 470 boys are shown in the following Table:

Group	*Tongue-agility Mean*	*I.Q. Mean*	*K–D Music Mean*	*Number*
Girls	16.98	101.75	47.95	430
Boys	17.56	100.94	45.40	470
Both	17.29	101.30	46.70	900

When tongue-agility and I.Q. scores were correlated an r of minus .02 ±.02 was found which shows that the two values are unrelated 100%. The coefficient of +.11 ±.02 between the K-D Music Test scores and the tongue-agility scores shows very little overlapping for the total population of 900 subjects. Obviously the two tests measure different functions. The coefficient of correlation between the K-D Music Test scores and scores in intelligence for the entire population is +.33 ±.02, the r that is obtained most frequently with little variation.

When the one hundred best tongue-agility scores were segregated from the rest and the corresponding scores in I.Q. and music were correlated, the correlation coefficient advanced slightly to +.37 between I.Q. and music scores; and reached +.31 for tongue-agility and K-D scores. When the poorest one hundred tongue-agility scores were segregated and the corresponding scores in intelligence and music correlated, we found an r of only +.02 between I.Q. and tongue-agility and +.25 between music scores and tongue-agility. When we compare the means of the top and bottom deciles* we see how the scores are bound together.

Group	*Test*	*Mean*	*Number*
Top decile	I.Q.	100.24	100
Lowest decile	I.Q.	102.20	100
Top decile	Tongue-agility	21.31	100
Lowest decile	Tongue-agility	13.22	100
Top decile	Music Test	55.70	100
Lowest decile	Music Test	50.20	100

Observe that the lowest 10% earns a higher I.Q. than does the top 10% of our population but not so with the music scores, which show a 5½ point gain by the top over the bottom decile. Too much importance cannot be attached to this study for it is atypical in a number of important respects. The scoring on both the music and the intelligence tests reaches a peak at the 10-year-old level in the former and at the 11-year-old level for the latter, declining considerably in both as we advance in age. The tongue-agility scores increase regularly, though slightly, throughout the entire range of years from 9 to 19. Of course, sampling is a matter beyond the control of the experimenter, who is obliged to take conditions as he finds them, but a generalization based upon an atypical population is not likely to resemble one based upon a normal one. The writer uses the term "normal" with the normal distribution curve in mind.

* A "decile" is one of ten equal divisions of the total population.

The Table which follows shows how three groups compare in tongue-agility, right-hand motility, and left-hand motility. The three groups are left-handed boys and girls, right-handed boys and girls and ambidextrous boys and girls. The number of subjects measured was only 28 for the ambidextrous group, 94 for the left-handed group and 1,039 for the right-handed group. The measurements were made by Byer [20] and others on the basis of nationality, sex, age and training.

Group	*Tongue-agility Mean*	*Left-Hand Mean*	*Right-Hand Mean*
Left-handed	17.65	17.56	15.65
Right-handed	17.51	15.06	18.08
Ambidextrous	18.18	17.39	18.29

With tongue-speed approximately the same as right-hand tapping-speed, the ambidextrous group is superior to the other groups in both measurements and almost the equal of the left-handed in left-hand motility. They represent the best achievement of the three groups. The difference between left and right hands is less than one point. Next comes the left-handed group, although the two hands are unequal by two points; while the right-handed groups show the greatest difference between right- and left-hand speeds of three points. For all three groups, tongue-agility is comparable to the score earned by the stronger or dominant hand in motility.

Our interest in tongue and tapping measurements may not be too clear to the reader. It is not only important from a purely scientific interest but in what it promises when applied to some of our problems in music. Violinists have been frequently asked whether their instrument requires more left- or right-hand discipline and control. The author has confronted many distinguished violinists with the problem only to learn that a dichotomy of opinion exists. Opinions coming from renowned performers stress left- or right-hand superiority and overlook ambidexterity, When the same question is asked of pianists, the answers tend to be more in agreement, for the right hand of the player carries the more important responsibility. For the organist, in addition to left- and right-hand manipulation of manuals, the feet play an important role, independently and in conjunction with the hands. Future studies must establish norms for the different musical instruments in terms of some standard of conformity or non-conformity to values of ambidexterity. After large populations of violinists, pianists and organists have been measured we will be in a position to answer these questions more accurately and eventually select those who possess superior equipment as indicated by our norms. These are not the only requirements but they warrant consideration along with other aptitudes that condition success or failure.

Another very interesting result of the Byer study concerns tongue-agility differences linked with sex. The difference between trained boys and untrained boys is considerable on the three measurements. The difference between trained girls and untrained girls is negligible. Even the untrained boys earn higher scores than the trained girls, which supports the position of the writer in subordinating training as such to a minor role. It is selection rather than training that accounts for the difference, although sex must not be overlooked.

We have attempted to learn how tongue-agility scores relate to age, sex and intelligence and the study about to be reported adds music test scores. Over 1,000 students ranging in age from 9 to 19 years and in grades from 5 through 8 and 11, almost equally divided as to sex, were examined in the public and parochial schools of Burlington, Vermont, by Hurd.[68] The tongue-agility testing machine was set up in a room other than the classroom, where the test and the use of the machine were explained. The students were instructed to hold the microphone close to the mouth and repeat the syllable "tu" as rapidly as possible. The intelligence scores were taken from the existing school records. The tongue-agility mean for 560 boys is 14.93, with the 5th grade earning 3 points less and the 11th grade approximately 2 points more. The scores by sex are very similar.

Grade	*Sex*	*Tongue-agility Mean*
5	Boys	11.49
5	Girls	11.67
6	Boys	13.70
6	Girls	13.57
8	Boys	15.74
8	Girls	15.49
11	Boys	17.09
11	Girls	16.65
Total	Boys	14.96
Total	Girls	14.93

We must remember that these values represent a 3-second interval of time and that the average rate of tonguing is approximately five times per second. The average K-D Music Test scores by sex for the total population are: boys, 187.40; girls, 190.35; and in intelligence for boys, 103.77; girls, 105.18. The correlation coefficient between tongue-agility and the music score based on the K-D Music Test is +.42 ±.02; but only +.09 ±.03 between intelligence and tongue-agility scores. To show further what an r of +.42 means in "going-togetherness," let's compare the top and bottom 16% of the population. The best sixth of the population earns a music score of 214.28 and a corresponding tongue-agility score of 16.37. The poorest sixth of the population earns

162.22 on the music test and a tongue-agility score of only 13.07. In other words, the poorest in music are one tongue movement per second slower than the best sixth, on the average.

Whether this advantage in tongue-speed will in itself make the difference between a poor and a good wind-instrument player cannot be presumed at the present time for lack of evidence of tongue-agility measurements of outstanding wind-instrument performers. It is regrettable that we have no norms at present to make it possible for us to establish a standard. However we can say that our tongue-agility test measures something which is also measured in part by the K-D Music Tests, or the correlation between it and the music scores would not be what it is. That it also measures something more goes without saying. If the two tests measured identical functions, they would correlate plus 1. As it is, there seems to be a moderate amount of duplication, but still plenty of room for both tests.

The Ream motility test was used by Lehman [91] on 112 musically superior and inferior subjects, selected by the K-D Music Tests in Lake Placid, New York, from grades 6 through 12. He used the standard materials and methods for the measurement of motility and, in addition, measured metabolism, pulse and blood pressure. When measuring motility rate, he compared the scores of the talented and untalented musically, both with and without musical accompaniment. When the subjects were allowed to hear music while taking the motility test, scores improved for both groups. The talented group had the faster motility rate in both the accompanied and unaccompanied trials. The means of 36 and 31.5, respectively, were earned in 5-second periods by the talented and untalented. With musical accompaniment the mean score for the talented rose to 38.

Although many of our studies employ the same testing materials and procedures that have been used with other groups of subjects, the duplication of studies not only increases the size of the population measured but also enables us to check on the validity and reliability of testing instruments and results. With a more homogeneous group numbering 236 children in grades four through eight, Orszewski[125] measured tongue-agility, tapping-motility, tongue-length, hand-length and body-height. His subjects attended the Stella School and St. Stanislaus School in a suburb of Binghamton, New York.

Again, the trained earned higher scores in tongue-agility and motility, had greater length of right and left hands and more body-height than the untrained. In tongue-length, measured with the aid of a tongue depressor and an attached strip of litmus paper which the acids of the tongue discolored, the trained earned higher scores than the untrained. Right-handed children were superior to left-handed children in all measurements but one and that was the tapping-speed for the left hand of left-handed children. When we compare the boys and girls, the boys are superior in every measurement, including raw measurements for tongue-length; however, when height is used as a denominator, it appears that the ratio of tongue-length to body-height for girls is greater than that for boys. Taking the difference in height for the sexes into consideration, girls have longer tongue-ratios than boys, which may account for the slower tonguing speed of girls.

From grades three through eight, 352 children in four elementary schools and one junior high school of Syracuse, New York, were tested by Grier[55] for tongue-agility, tapping-speed, tongue- and hand-length and height. In tongue-agility, the scores for boys and girls are quite similar in the earlier grades, but in the sixth grade and above the boys are superior to the girls. The means for all boys numbering 200 is 13.40; the mean for all girls, numbering 152, is 12.63. In the stronger hand — the dominant hand — the motility rate is 16.96 for boys and 16.32 for girls. The weaker hand motility rate is 14.45 for boys and 13.76 for girls. The scores for total population are 13.02 for tongue-agility, 16.66 for stronger hand, and 14.15 for weaker hand. All measurements represent a 3-second interval of time. For both boys and girls the tongue-length measurement shows little change over the range of six grades; the 3rd grade averaged 1.22 and the 8th grade 1.26. In hand-lengths, left and right measure the same for girls, but the left hand is longer than the right for boys. Again, when height is considered, the tongue of the girls is longer in proportion to their height than the ratio of the boys. The heights for this group by sex are 56.20 inches for girls and 56.90 inches for boys. The scores for boys are higher than those for girls on most measurements. The correlation between height and tongue-agility is ±.40; between motility scores for the weaker hand and the tongue-agility +.41; tongue-agility and tongue-length for boys +.26 and for girls −.11.

With only twenty-two left-handed children in this study, Orszewski found them to be shorter in height, slower in tongue-agility, shorter in tongue-length, slower in right-hand motility but speedier in tapping-speed for the left hand than either the trained or the untrained. One conspicuous difference in measurement was that found between the length of left and right hands. There is very little difference in hand-length for the right-handed subjects, although the right hand is slightly longer. In left-handed subjects, the left hand is considerably longer than the right.

In a study of a larger population, Thurston[178] found the difference of 3 taps in 3 seconds between the right and left hands of the right-handed subjects. This difference is based on the measurement of 1,039 subjects. He found a difference of 2 taps in 3 seconds favoring the 94 left-handed subjects and only 1 tap in 3 seconds, the difference between left- and right-hand speed, favoring the 28 subjects who were ambidextrous. The highest scores reported by Thurston were earned by the ambidextrous in tongue-agility and right- and left-hand motility. The left-handed subjects were inferior to the right-handed, when the strong and weak hands were compared, by approximately ½ tap in 3 seconds. They were also a little speedier in tongue action. When 1,000 right-handed boys' and girls' scores are compared in the three tests, we find the girls earn approximately ½ point less. The means are:

Test	*Tongue-agility Mean*	*Motility Left-Hand Mean*	*Motility Right-Hand Mean*	*Number*
Right-Handed				
Boys	17.71	15.36	18.38	531
Girls	17.29	14.75	17.79	508
Ambidextrous				
Boys and Girls	18.18	17.43	18.32	28
Left-Handed				
Boys and Girls	17.65	17.56	15.65	94

Moderately high correlations were yielded by these measurements, as the following r's show:

Test	*Correlation Coefficient*
Tongue-agility and	
Right-Hand Motility	+.59
Left-Hand Motility	+.57
Motility	
Left and Right-Hand	+.63

All of these correlation coefficients are reliable and show overlapping. Actually when tongue-agility is being measured the score is an indication, in part, of what the subject may be expected to do in motility but the reader need not be reminded that there will be error in the motility score since the correlation is not perfect. Realizing the scope of the investigation and the need of caution in interpreting the results, Thurston concludes that boys are superior to girls in all measurements; that there is a tendency for scores to increase with age; that the three classifications rank in descending order from ambidextrous, left-handed, and last, right-handed; that the weak hand seems to suffer from fatigue as the test progresses, so that endurance may be a conditioning factor; and that while the correlations are moderately high, predictions should be made cautiously, for they may contain error of some size.

To date 5,235 boys and girls between the ages of eight and eighteen have been tested individually with our electronic machine for tongue-agility. For the 3-second period the 2,716 boys earn a mean of 16.77, and the 2,519 girls earn a mean of 16.21. The mean for the total population is 16.51.* Although the generalization must be made with reservations, it is conceivable that the slower tongue-agility for girls may be due to a somewhat larger tongue ratio which our measurements have disclosed. The greatest difference found between the sexes is that recorded for boys and girls of Italian extraction. The boys are .59 ahead of the girls in mean score; this difference is based on 1,000 cases. With only 660 measurements the German girl is slightly superior to the German boy by .22. While the girls may have a reputation for endurance and speed in matters vocal, the results of testing tongue-speed prove it to be unearned! The means for each age level from nine through eighteen show that over a 10-year period the average increase in agility is just about .15 per second per year, truly a trivial gain.

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* Computations by Olive B. Ransom, Syracuse University, 1951.

10

Stroboscopic Measurement

Before reporting the studies in which the chromatic stroboscope* was used, it may be helpful to describe the instrument. The pitch-measuring device was built for the precise and rapid measurement of frequencies in the range represented by the piano keyboard. By an entirely visual method, the deviation of a given tone from the equally tempered scale, based on the standard A of 440 cycles per second, may be read directly. The chromatic stroboscope may be used to tune pianos, organs or any other musical instrument, to investigate pitch, to help with intonation problems in musical performance and to aid teaching. The College of Fine Arts, Syracuse University, procured one of these instruments shortly after the instrument was made available and immediately a number of pitch problems were under investigation.

A demonstration of the chromatic stroboscope was being made before a class in acoustics in the fall semester. A violin major was asked to play open strings with up and down bows, making a crescendo with every bow. The purpose of the demonstration was to exhibit the stroboscope and show how quickly and easily the instrument can be read. Most of the class gathered around the violinist and watched the dots move clockwise and counter-clockwise as our violinist drew his bow alternately up and down. Movement of the dots meant only one thing: namely, a change in pitch with a change in bow direction. The open strings were being played, that is, without being touched by the fingers of the left hand. Then followed a brief period of discussion in which the students attempted to explain what they had seen and heard but neither they nor their teacher engaged in anything more than speculation.

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* Conn Chromatic Stroboscope, C. G. Conn, Ltd., Elkhart, Ind.

Could it be due to false strings, direction of the bow, change in bow pressure, change in bow velocity, or other causes? We wanted to know, through accurate measurement, the part played by bowing direction and, next, the part played by changes in dynamics. The preliminary study, limited exclusively to string-instrument intonation, with open strings, was launched by Harrington.[58]

Fifty string players took part in the early weeks of the experiment, including teachers of strings, professional string players, college string majors and school children who had had sufficient string instruction. Not all were violinists; some were violists, cellists and bass players. First the open strings were tuned meticulously with the aid of the stroboscope, eliminating all pitch errors. The subjects were asked to make no dynamic changes for the first variable was solely the direction of bowing. Each performer played before the microphone of the stroboscope and the pitch variations were read in cents.*

These deviations were recorded immediately. Next the open strings were played very softly, then very loudly, and again the deviations were recorded. When 50 subjects had been measured and the results tabulated, it was evident that neither the direction of the bow nor the intensity level was linked with sharping or flatting consistently. It was at this point that Harrington asked to modify the study, for he had observed two other variables that were not being considered in the preliminary study. These were pressure and velocity of the bow. Having achieved nothing in establishing a cause and effect relationship in the preliminary study, we abandoned it and started anew.

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* The "cent" is a unit of pitch equal to 1/100th of a semitone.

String players in the schools of Syracuse, Lyons, Cazenovia, Camden, Canastota, and Pulaski, in central New York, the Syracuse University Orchestra, Syracuse Symphony Orchestra, and some string players in the New York State School Music Festival, held in Syracuse, were examined. The new instructions called for changes in pressure and also velocity on open strings with up and down bow. The results obtained reveal a consistency of approximately 100%.

With only one exception, sharping accompanied an increase in bow-velocity for up and down bows. With only two exceptions, flatting accompanied an increase in bow-pressure for up and down bows. For 111 string players, increase in the pressure of bowing resulted in flatting 4.65 cents; while increase in the velocity of the bow resulted in sharping 2.50 cents. The difference linked with up and down bow was so insignificant that it was completely ignored. The viola, cello and bass flat 4.79 with increased pressure and sharp 3.34 with increased velocity. The professionals make the greatest deviation in pitch; a 5.95 cents drop with increase in pressure and 3.50 cents rise with velocity. The deviation or error in intonation on the violin, exaggerated as it is, resembles the increased error in scale-singing found in the measurements of the more experienced singers, when compared with inexperienced singers.

It is now possible to explain the intonation problem of the young man who, unwittingly, was responsible for initiating this investigation. Unintentionally he was using pressure on the bow when the direction of the bow was down and using velocity changes when the bow movement was up. As a result, he was playing open strings alternately flat and sharp. When deviations in intonation are deliberately introduced for some preconceived esthetic purpose, which achieve desired expressive results, there can be no criticism. Intonation errors which serve no expressive purpose but merely confuse the hearer by shifting the pitch up and down cannot be accepted.

Some of our early stroboscopic studies dealt with voice intonation, measuring the accuracy of pitch in ascending and descending scales; the effect of diminuendo and crescendo, the effect of different vowels, different dynamic levels, different intervals, etc. One of the first of the vocal studies was that made by Hurley,[69] with 300 high school children of Oswego, New York, and 50 members of the boy choirs of St. Paul's Church and St. Mary's Church of Oswego. All of the children were selected because of their superior scores on the K-D Music Tests. The pitches were sounded by the piano and unless different vowels were being tested the subject used the vowel ä at A, 440 double vibrations, and E, the tempered 4th below. Many interesting facts were revealed by this study. When boys sustain a tone with no change in dynamics, they start the pitch ½ a cent sharp and release it 6 cents flat. Girls attack the pitch 2 cents sharp and raise it approximately 2½ cents in a 10-second period. Changes in dynamic level are all accompanied by flatting for boys and sharping for girls. Vowels ä, ō, and ā are sung low by boys, minus 2.4, 2.4, and 1.7. Vowels ō, ē, and the hum are sharp plus 1.8, 2.6, and 2.8 respectively. Girls sing all vowels high, starting with ä at 2.8 and climbing to 7.8 for the hum. The order with increasing error is ä, ā, ō, ē, ū, and hum.

Some of the conclusions drawn by Hurley from the pitch measurements are: The loss of voice control when sustaining a single tone may be due to reduced breath support which causes flatting. When tones are reproduced softly, there is a slight tendency to flat. When tones are reproduced loudly, they are sharp. The diminuendo is sung sharp initially but drops in pitch as the intensity drops. The crescendo is sung sharp initially and the rise in pitch parallels the increase in intensity. When all scores are combined, ä is the lowest; ā and ō are somewhat higher and ū and ē are sharp. The hum is higher than any of the vowels. In comparing standard deviations for all measurements, a change from one vowel to another produces much more pitch variation than any of the other considerations under investigation. When all the measurements of this study are "pooled," the mean score based upon 6,300 reproductions indicates a general tendency toward sharping.

The pitch errors associated with intervals and direction of skip were investigated by Ordway [124] with the aid of the stroboscope. Using high school and college subjects, ten intervals were sung in ascending and descending order after each "broken" interval was played on the piano. All pitches were sung on the ō vowel. A total of 180 students participated; 100 college and 80 high school students. Many of the college students were music majors. The ascending intervals were major second, minor third, major third, perfect fourth, augmented fourth, perfect fifth, minor sixth, major sixth, minor seventh, and major seventh. The descending intervals were minor second, major second, minor third, major third, perfect fourth, diminished fifth, perfect fifth, minor sixth, major sixth, and minor seventh.

An average error for the ten ascending intervals was a sharping in pitch of 5.2 cents and for the descending intervals a sharping in pitch of 4.9 cents. It must be understood that sharping the upper tone in an ascending interval expands it, while raising the lower tone of a descending interval contracts it. While the error is quite similar in size for ascending and descending intervals, the two tendencies are diametrically opposed. The most accurately sung interval both ascending and descending was the augmented fourth going up and the diminished fifth going down with an error of 3 cents. The poorest ascending interval from the standpoint of intonation was the major second with an error of 7.2 cents; and descending, the minor second with an error of 6.2 cents. The descending intervals were sung just a trifle more accurately than the ascending ones. For some unexplainable reason the high school students earned higher mean scores than did the college students. Sharping is the common intonation fault of most of our subjects and the average error is approximately 1/20th of a semitone.

Most readers are familiar with the characterizations "bright" and "dark" as applied to instrumental color. The viola, for example, may be said to possess a dark quality as compared to the violin, which is bright in quality. It is also true that the brighter tone seems to be more concentrated while the darker tone is more diffused. The bright tone is more brilliant while the darker one is more somber. When the string player mounts a mute on the bridge of his instrument the quality is changed to a darker shade. Spectra of muted and unmuted strings show that the lower frequencies are little changed by muting but the higher overtones are considerably dampened.

In a stroboscopic study of the voice, in which one hundred college and one hundred high school singers were asked to reproduce three different pitches, D (587 d.v.),* A (440 d.v.), and D (293 d.v.) with bright and dark quality of tones, Preston [133] investigated the effect of color on pitch. By allowing adequate opportunity for practice with the mouth "short," a bright tone is produced. By pronouncing the same vowel with the mouth "long" (as in the "oo"-pool) the timbre changes to dark. The population was also divided into trained and untrained for further analysis.

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* Double vibrations.

The trained college singers dropped the ē from the bright level of plus 10.16 to 6.7 cents for the dark quality at 587 d.v. They dropped the ā vowel from the bright level of plus 7.94 to 5.74 cents for the dark quality and there was no appreciable change for the ĕ vowel when darkened, but the ä vowel ascended an inaudible ½ cent when darkened. At 440 d.v. the first three vowels dropped when darkened, but again the ä rose 1½ cents. At 293 d.v. the first two vowels were lowered but the last two rose very slightly. For the trained high school singers, all vowels were sung sharp for the bright quality and rose on the average about .7 cent when darkened, which is inaudible. The tendency to sharp when singing bright vowels was found in exaggerated form for the trained college singer averaging 7½ cents for the four vowels. The average sharping for the trained high school singer was 6 cents. Both groups sing sharp whether the tone color is bright or dark. Only 34 of the 200 subjects were untrained: 15 at the college level and 19 at the high school level, and they reversed the results reported for the trained. The college students sharped their vowels when they attempted to darken the color and the high school students flatted their dark vowels a bit. Curiously, the untrained sang both the bright and dark vowels more accurately in pitch; although they sang sharp both ways, they were usually closer to the standard pitch. It was a rare achievement to find a subject who could sing the four vowels on precisely the same pitch level. This difficulty may account for some of the changes in pitch, unrelated to color or the standard frequency on which the vowels were produced.

Over three hundred preliminary tests were made by Gerrish [46] in order to establish a favorable testing technique and locate subjects who were musical enough to be tested. Many of the high school and grade school children were unable to sing the upper pitch C (522 d.v.) after singing the lower B flat and many who tried were unable to keep within the range of measurement provided by the machine. These individuals were dropped from the experiment. Five vowels and a hum-tone were sung on three pitch levels at three levels of intensity. In order to facilitate the singing of the various vowels the consonant n was used to begin each one. Eliminating the preliminary tests, 166 subjects were selected, 52 from the Crane Department of Music, Potsdam State Teachers College, New York, 63 high school students from New Franklin Academy, Malone, New York, and 51 7th- and 8th-grade children of the Malone grade schools.

Again we find that the college group tends to sing sharp as the pitch standard rises, while the grade school group tends to sing sharp as the pitch falls. The high school group bears some resemblance to each of the other groups and seems to bridge the gap between them. In this study there is a general tendency at maximum intensity to sing above previous levels and above the standard tone. This characteristic holds for all tones and all groups regardless of sex. The two vowels which are consistently sharp in reference to the standard tone and the other vowels are: ē, ū and hum.* The lowest vowels are ā, ō and ä. Constructing a scale showing the relative positions of the vowels measured stroboscopically, Gerrish lists them in the following sequence: ē, hum, ū, ā, ō and ä. Disclosing a pattern of error in intonation and direction for his total population, assuming the hum to be in tune with the standard tone represented by a broken line, the pitch curve may be represented as follows:

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* For convenience, the "hum" is classified as a vowel.

ē
hum - - - - - - - - - - - - -
ā ū
ō
ä

However, no sweeping generalization can be made regarding the decrease in intensity and its effect on pitch, since the data show no well defined tendency.

Employing a tonoscope, which functions stroboscopically, Miles[105] found that vowels fell into three groups, the lowest being ō, next came ä and ū sung moderately sharp, and finally, ē sung decidedly sharp. Generalizing on these tendencies, the conclusion is: the higher the dominating overtones in a vowel quality the higher that vowel will be sung. The hum assumes a middle place with the vowel ä. By sex, women tend to sharp in reference to the standard and the size of the error is about equal for both sexes. An increase in volume or loudness exaggerates the tendency to sharp.

We have considered the influence on accuracy of intonation exerted by pitch-level, intensity-level, vowel quality, size of interval, direction of interval, ascending and descending scale, dark and bright tone color, age, sex and training, but we find the vibrato the most fluctuating variable in regard to both pitch and intensity. It is probably misleading to refer to the vibrato as a phenomenon producing error in pitch. It must be considered a natural fluctuation in neural discharge, which in turn produces periodic and rhythmic changes in the muscles controlling vocal behavior. These periodic pulsations are spaced at intervals of time that are roughly .16 seconds apart. The reader is probably familiar with the tremor-rate and can easily demonstrate its nature by performing the simple act of lifting a chair; then, with arm extended, holding it at shoulder height with one hand. It will be only a matter of seconds until the tremor-rate will be experienced, first as an arm-tremor and then as a body-tremor. As you become more fatigued the body will shake visibly and uncontrollably.

Muscles are meant to function rhythmically and require replenishment between periods of exertion. We also have waves of attention which may be easily plotted and measured. The crests and troughs alternate with rhythmic regularity. The troughs are periods of reduced sensitivity as a simple experiment will prove. If the reader will hold a small watch far enough away from his ear so that the sound is just audible, he will discover that the sound is intermittent. It will be interrupted rhythmically during attention curve troughs, for these coincide with periods of fatigue and regeneration.

When we realize that most bodily functions are rhythmic and understand that rhythm conserves energy by balancing input and output, then we are ready to consider the vibrato as a physiological manifestation of work and rest. Remember that these are not voluntary acts but acts controlled by the sympathetic nervous system. The nervous impulse to contract forces the muscles to stretch the vocal membranes and as a result the pitch goes sharp. When the muscles relax, tension on the membranes is reduced and the pitch goes flat. Actually it is almost humanly impossible to produce a vocal tone rigid in pitch and intensity. The author [82] has photographed hundreds of tones but has yet to encounter one that resembles the tone of a tuning-fork in steadiness. When the vibrato is disorganized, as it may be infrequently, fluctuations in pitch and intensity are present but they may not be organized cyclically. We find deviations both above and below the mean-pitch of the tone, but they do not follow the curve pattern progressively from low to higher level or the reverse. The disorganized vibrato does not pulse.

When a violinist rocks his finger back and forth on a string, he produces changes in pitch by lengthening and shortening the string. The shorter string produces sharping and the longer string produces flatting. The rocking of the finger produces a panorama of pitches, more or less regular in rate, moving steadily between limits of pitch $\frac{1}{2}$ to $\frac{1}{4}$ tone apart. The violinist deliberately attempts to simulate the voice vibrato and does the act of imitation quite well. The violin vibrato is a voluntary act, of course. The author has photographed the pulse of the violinist while drawing the bow on a stopped string, when attempting to suppress the vibrato. The blood vessels in the fingertips expanded just enough to raise the pitch by shortening the string. The change in pitch is rather small but rhythmic and clearly reproduced in sound photography.

As we have suggested, the pitch change is not the only change occurring in the voice vibrato, although it is probably the most conspicuous one. The periodic changes in loudness are also very important. They probably have their source in the rhythmic nature of breath support. When the voice membranes stretch synchronously under pressure of breath and muscle contraction, we have the type of vibrato named the "parallel" vibrato.[82] The name comes from the fact that when pitch and intensity curves are plotted, the peaks of the two curves as well as the troughs coincide. Higher pitches and louder intensities accompany each other, as do lower pitches and softer intensities. Most vibratos belong to this classification. This organization gives greater prominence to the top of the pitch-curve, while the lower frequencies are relatively subdued. However, some of the pitch fluctuations are less audible because the entire range is not equally supported by maximum intensity output.

There are many other types of vibrato, but the second, in terms of frequency of occurrence, finds the pitch and intensity curves out of phase by an angle of approximately 90 degrees. The crest of the pitch curve is now accompanied by the trough of the intensity curve and vice versa. Now the lower pitches are heard with greater prominence and the higher pitches are dampened. When the vocal bands (more correctly, membranes) are relaxed, air pressure from the lungs forces them to vibrate through a greater amplitude. The out-of-phaseness may be more or less than 90 degrees between the two forces and, therefore, the pitches that are strongest may move back and forth, depending on the angle of support from the intensity curve.

In some voices the pitch factor alone is organized in the shape of an S-curve, while the intensity curve is irregular and unperiodic. In other voices the intensity curve alone is organized periodically and although the pitch fluctuates, it does so without any organized periodicity. The last two types of vibrato the author has named pitch and intensity vibratos. Children frequently exhibit the latter type. When we deliberately attempt to suppress the vibrato of the voice, instead of eliminating it, the organization of pitch and intensity merely changes. The actual elimination of the vibrato may be a physiological impossibility.

While we have stressed pitch and intensity, overlooking the time and quality variables would be a serious omission. The rate of the vibrato is not constant by any means. The author has measured vibratos varying in rate of occurrence from 4 to 9 per second but the average is approximately 6 per second. These pulsations may be measured in pitch or intensity and show the number of cycle recurrences or pulses. The quality variable is a little more difficult to identify without acoustical explanation but as in the case of bowing a string, when the direction of the bow is changed, the quality of the tone changes. A trained ear can identify the direction of the bowing movement from the sound quality of tone produced. So in the vibrato, we hear not only a panorama of pitches as they rise and fall between upper and lower limits but changes in quality or color as the pitch and intensity fluctuate.

In a well-organized vibrato we do not hear all of the pitch changes for much of the pitch curve is so reduced in intensity that many pitches become inaudible. We hear chiefly the pitches that are supported by the peak of the intensity curve and probably not much more. This phenomenon gives the voice a pulsating effect which we value esthetically. When the intensity curve is not properly organized and all the pitches are supported with equal intensity, the wobble of the voice becomes disagreeable, for too many different pitches are competing for attention and no predominant pitch is established. This may be the major structural difference between the beautiful vibrato and the disagreeable tremolo. The conflict arising between all the tones equally stressed throughout the range of $\frac{1}{2}$ tone or more and the hearer's demand for a narrow pitch focus can be very disturbing.

In spite of merited criticism of exaggerated vibratos, we value the beautiful vibrato as a fundamental attribute of artistic singing. It is the medium for the conveyance of feeling in vocal expression. It is the product of neuromuscular behavior that makes expressive singing possible. Psychologically it spells emotional sensitivity. Actually it makes the reception of music easier to accomplish, distributing the strain of attention rhythmically. It gives life and substance to the tone that otherwise would be rigid, brittle and expressively barren.

11

Music-reading Measurement

The acquisition of skill in music-reading is one of the more important technical objectives in music education today, as it was more than a century ago. Since so much time and energy is devoted to this objective in our school systems and so little is being achieved in reading proficiency, the wisdom of pursuing it is seriously questioned. There are leaders in the field of music education who maintain that it is a feasible and easily realizable objective; others contend that it is beyond the reach of the rank and file in our schools, requiring specialized endowments found only in the more gifted children. Being what it is, mass education attempts to avoid differentiation in methods or materials and addresses itself to the task of achieving a goal in reading regardless of the attitude, equipment and need of the individual child for whom the educational discipline is designed. As a result, much that is done to teach music-reading in our schools accomplishes very little. This is inevitable when we attempt to universalize an objective without taking the learner's capacities and interests into consideration.

The highly technical problems associated with music-reading are more properly those for the vocationally-minded music student than for the masses. Special endowments for successful accomplishment are required and these endowments are not too generously distributed. Many of our professional singers do not acquire easy facility and proficiency in music-reading. When we consider music-reading in the light of motivation and need, we realize that the will to read is not sufficient in itself to produce good readers.

The music-reading objective was more defensible when it was introduced almost one hundred and fifty years ago. The school population was only a fraction of its present size and much more selective, consisting mostly of those who were preparing to enter the learned professions of medicine, law, and the ministry. Before the days of the phonograph and player-piano, to hear music one was obliged either to make it or to be within hearing range of music being made by others. Mechanical and electrical reproduction of sound was unknown. If the community, the church, the school and the home needed music it was produced by members of the community, the church, the school, and the home. In serving society the schools were obliged to train its clientele in useful and necessary skills.

Music in those days was also taught as a discipline, for educators believed generally in formal discipline and the transfer of learning. These values have largely disappeared from modern educational theory and practice. For those who have the equipment and need, music-reading skills are a real asset, but for those who are unendowed, devoid of adequate reading equipment, there is little discipline, merely drudgery and disappointment. The happiness and usefulness of most people today does not hinge on music-reading skill, for so few are required to read music after leaving school. When we test our school population we learn how depressed and depressing the level of music-reading is.

In the studies showing regression of learning, the symbols employed in musical notation were frequently known by lower-grade children and subsequently forgotten as shown by lower scores of many in more advanced grades. Whenever we take the trouble to measure the relationship between knowledge of musical symbols and the ability to use them, we find to our embarrassment that the two values are at times in conflict. One dramatic instance, which stands as an indictment of our pedagogical procedure, is that revealed by the Gary, Indiana, study of Lenoire.[94] The reader may recall that two hundred white and two hundred Negro children were measured with the Kwalwasser-Ruch Musical Accomplishment Test, along with many other educational measures.

Among other things, two diametrically opposed considerations show that the whites were far superior to the Negroes in nine of the ten tests. They knew more about musical nomenclature than the Negroes and less about using it. First, in an academic way (reminiscent of the mental discipline days) the whites were superior in knowledge; and second, in a functional way, requiring the application of knowledge, the whites were inferior in skill.

It is quite obvious that knowledge of notational symbols does not give one mastery in the use of the symbolism. In spite of the fact that the Negro was much inferior to the white child in naming, describing, identifying, classifying and defining items of staff notation, he had greater mastery of this material when confronted by a more natural music-reading situation. While the whites could *talk about* notation they could not *translate* it into music. Detached from music-making, as the notational items are in the first nine tests, the Negroes made a poor showing, but put together in proper musical configuration realistically, the Negroes were superior to the whites in making music notation function.

When we say that this study is an indictment of present-day methodology in music education, we mean just that. Functional rather than academic training is needed to achieve skill in reading. Symbols in music are commands to act — to make music, not to talk about musical values, theoretically. This study casts reflection on the wisdom of over-stressing knowledge at the expense of the more natural, simple and meaningful response of singing.

The Holmes School study of Earhart[30] supports this thesis strongly. In an experimental study to determine the relative effectiveness of creative activity as compared with the conventional type of musical activity, 52 children of the fifth grade, Holmes School, Pittsburgh, Pennsylvania, were organized into two classes. The children were properly equated as to talent and achievement and given instruction in music along preconceived lines for the period early in February to the middle of June. Classes met three times a week for a total of 57 periods. Instructional material and teaching procedures were the same in all respects, with only one exception. During the last 15 minutes of each period the experimental group composed and recorded original songs. Inasmuch as the music period was 45 minutes in length, this represented one-third of the total time devoted to creative work. At the end of the semester, the two groups were tested with a set of measures designed to evaluate the results of the experiment. The author witnessed some of the terminal tests and was impressed with the superior reading ability shown by the experimental group in singing unfamiliar material. They seemed to hesitate and falter less than the routinely trained group and their results on a dictation test showed them to be greatly superior with an advantage in score indicating complete reliability of the difference.

Another study using the philosophy of the creative approach was undertaken by Lyman [97] employing three hundred boys and girls, half of whom were characterized as good music-readers and the remainder as poor music-readers. The children represented grades five through eight in Montour Falls, Fall Creek and the Belle Sherman Grade School of Ithaca, Prospect Grade and Boyd Grade Schools of Solvay. Grade schools of Spencer, Newfield, Marcellus, Candor, Watkins Glen and a few schools in Syracuse, New York, were also measured. The classroom teacher in every classroom was asked to pick out three of her best and three of her poorest music-readers to whom a completion test in music was administered individually. The antecedent phrases of three unfamiliar songs were mimeographed on a test-blank along with the words of both the antecedent and consequent phrases. The notation of the consequent phrases was always omitted. The experimenter sang and played, with the aid of the piano, only the antecedent phrase, repeating it two or three times.

With the words before him, the child was asked to complete the song, unassisted, while the experimenter recorded in musical notation the terminal phrase as sung by the child. If the terminal phrase was not altogether satisfactory to the child, he was encouraged to change it until it was satisfactory. The responsibility of writing was assumed by the examiner, exclusively. Then the scoring of the test was done by comparing the child's terminal phrase with that of the composer's original consequent phrase. Every correct pitch was given a value of 2; when the direction was right but the pitch was wrong the value was reduced to 1. If the pitch was wrong and in the wrong direction, it was given a value of zero. In regard to rhythm, each correct time value received a score of 1. If the time value was incorrect, it received a value of zero. This method of scoring made possible a maximum total score of 109 for the three songs completed.

A mean total score of 75.74 was earned by the 150 boys and girls chosen as good music-readers, while the poor music-readers earned a mean total score of 60.59 on the completion tests. In the good category, 55 boys were 2 points ahead of the 95 girls in the same category. In the poor category the 73 girls were 1 point ahead of the 77 boys in the same category. Statistically, the vast difference revealed by the critical ratio between the good and poor readers on this test confirms the judgment of the classroom teachers. But our results do more than merely confirm teachers' judgments, as important as that undeniably is; it shows us a relationship between skill in reading and the creative processes that is very provocative. Obviously, to recreate from notation requires original creation — composition, if that be the proper term.

A follow-up study somewhat expanded was immediately launched by Pollock [132] employing the completion test [97] used in the preceding study and the K-D Music Tests. In addition, each child's general school achievement for a 2-year period prior to the testing was ascertained arithmetically. In this study 288 children from intermediate and junior high schools of Nanticoke, Pennsylvania, were tested. In every class the classroom teacher was asked to select the three best and three poorest music-readers. These children were given the music tests and their records, supplied by the school office, completed the data needed. The comparison of the good and poor readers showed the two groups to be separated by better than 15 points on the completion test measuring creativeness or the ability to complete a musical sentence; and 17 points on the K-D Music Tests. The critical ratios of both pairs of scores are very significant, since the magnitude of the difference is tremendous. Again in school achievement the good readers are 11 points ahead of the poor readers and the critical ratio is again very great. Some thought-provoking correlations were found.

The r between the K-D Music Test and an unstandardized music-reading test score is +.85 ±.02. This coefficient is 50% accurate for purposes of prediction, there being one chance in two that a prediction based on the K-D Music Test score corresponds with the score earned on the unstandardized music-reading test, or vice versa. The r between the K-D Music Test and school achievement is only +.08, which has practically no predictive value, while the r between the K-D Music Tests and the completion test was +.30, in which the overlapping is about 5%.

Investigating a population of 1,175 children in 29 elementary schools from grades 3 through 6 in the city of Syracuse, Dalton[25] compared language-reading scores with teachers' judgment of success in music-reading; then correlated 554 scores earned on a short experimental music talent test built by the author* with scores earned on language-reading tests. The language-reading scores were earned on the New York State Reading Progress Test, Form Z, the Iowa Every-Pupil Tests of Basic Skills Test A, and the Reading Comprehension Test, Form M, for grades 3, 4 and 5. The experimental music test measured pitch, intensity, time, rhythm, quality and harmony. The 50 items comprising the test were recorded on tape and cut on 12-inch discs. When the language-reading scores of the good and poor groups were compared, they supported the judgment of the teachers, which was based upon success or lack of success in music-reading. A difference of enormous statistical significance was found between the two categories. The boys were found to be superior to the girls in both good and poor classifications on every grade level but the 3rd.

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* This test has been reconstructed and is now available as a standardized short test of native musical talent. It is published by Mills Music, Inc., New York City, with manual, scoring matrix, blanks and 10-inch phonograph record for school, studio and home use, under the title "Kwalwasser Music Talent Test."

In the second part of this investigation, in which the subjects were chosen on the basis of their music talent scores, the girls are better than the boys in the good classification and poorer in the poor classification, as revealed by their language-reading scores. The correlation coefficients computed were approximately +.40 but since they are based upon smaller populations and include subjects who were selected for either proficiency or deficiency in music-reading, they are quite unlike populations that are random in selection, and may not be trustworthy when applied to normal distributions. Nevertheless, the study shows considerable overlapping between the reading of language and the reading of music.

The reader may recall the Lambert [83] study which showed that one and one-half times as many good music readers as poor ones were found to have superior intelligence. In reverse, the same proportion was found in the poor category below the I.Q. of 90. She also found the poor readers inferior in their K-D Music scores by 11 points, using more than 1,000 children. Testing 2,140 children, Briggs [14] found the good and poor singers 16 points apart on the K-D Music Tests. In still another study, Holtzclaw [66] tested 2,690 children in San Antonio, Dallas, Fort Worth, Denton, San Marcos and Canyon, all in Texas. The two groups of 1,345 each were made up of early elementary grade school children differentiated on the basis of ability to sing in tune. In the poorer group were 410 monotones and others unable to carry a tune. In the good group were found those children who were superior in their ability to sing in tune. The difference between the two groups in I.Q. was considerable, for the poor group earned only 96 and the good earned an I.Q. score of 114. The difference represents roughly a value equal to one sigma or approximately 35 percentile points.

It is also interesting to note that the boys outnumber the girls 4 to 1 in the poor group and the girls outnumber the boys by 2 to 1 in the good group. A very revealing reaction linked with success in singing is also reported in this study, as 99.56% of the superior singers reported that they enjoy music, but only 75% of the poor group admitted that they enjoy music. When we compare the size of the two groups that dislike music, we see that 50 times as many poor singers dislike music. This proves again, if proof is again needed, that our attitudes are very closely linked with personal achievement. Although this fact may not be evident, it cannot be too cleverly concealed. In reality, attitudes are protective devices associated with frustration and failure, or success.

An ophthalmographic study of good and poor music-readers was made by Melnitz.[104] The ophthalmograph is a portable binocular eye-movement camera.[2] The binocular reading-graph, or eye-movement photograph, secured in the act of reading, gives objective information concerning eye coordination and the form characteristics as well as maturity of the reading habit. The data so obtained are the symptoms of the reader's efficiency. Generally, a reader is unaware of the way in which his eyes function as they follow the lines of print. The fact that he has little voluntary control over this activity increases the validity of the reading graph as an analytical and prognostic test. No other test furnishes objective information concerning the way in which the pupil attacks the printed page. Whether one takes the viewpoint that eye-movements are only the symptoms of reading disability or that they are the direct cause of the difficulty, experimenters in the field of reading agree for the most part that the eye-movements should be observed and studied as at least one phase of the problem of correct reading.

In addition to ophthalmographic measurements, Melnitz gave his 200 subjects the music completion test, the K-D Music Tests and an intelligence test. The children came from grades 5 through 8 and were chosen by the music teacher for their skill or lack of skill in music-reading. In every classroom an equal number of best and poorest music-readers were chosen, usually not more than 3 in each classification. These children were then given all tests and their scores were compared. In I.Q. rating, the 100 superior music-readers led the 100 inferior music-readers by 9 points or approximately 25 percentile points. The completion tests, which required the subject to complete a musical "sentence" after hearing the antecedent phrase sung and played by the examiner, showed the superior to be 15 points higher than the inferior, or approximately 40 percentile points higher. In the speed of reading the superior music-readers were significantly faster than the inferior music group.

In the number of fixations per 100 words (these are eye stoppages or periods of non-movement) the superior group had fewer fixations than the inferior group; the difference being 10.5 for 100 words. The difference in regressions (instances when the eyes move back from right to left instead of continuing the sweep from left to right) favored the superior music-readers. Based upon 100 words, the superior group regressed 15 times while the inferior group regressed 19 times. Comparing the average duration of each fixation, the superior reader stopped .23 second and the poor reader paused .24 second. The span of recognition also favored the superior music-reader for he had a greater span and a larger comprehension score. When the two groups were given the K-D Music Tests their scores were separated by 41 percentile points and the largest critical ratio of the study.

From studies of Weaver,[182] Bean,[6] Jacobsen,[70] Ortmann [126] and others who have experimented with music-reading using ophthalmographic and tachistoscopic measurements, a number of generalizations may be made concerning good and poor readers. Efficient readers are able to grasp four or more notes at a glance while slow stumbling readers are seldom able to grasp more than one or two notes at a time. The good reader looks ahead of his playing or singing but the poor reader either looks at the note he is playing or singing or very little beyond. Good readers are engaged in patterns as wholes, taken in at a glance, while poor readers see notes, which are incomplete patterns. From the data assembled, it is clear that a close analogy exists between reading of words and the reading of music. The Gestalt interpretation of learning which has been applied to other educational areas applies with comparable force to music-reading education. Large meaningful tonal configurations are the ones that function best, while spelling out note by note results in groping, stumbling and slow reading.

Testing children in grades five and six at Dunkirk and Fredonia, King [75] studied certain aspects of aural and visual responses of good and poor music-readers. He investigated five aspects of musical hearing: feeling for tonal movement, tonal memory, pitch discrimination, time discrimination, and rhythmic discrimination of the K-D Music Tests. The visual traits studied were near and distant acuity, visual perception, near and distant fusion, astigmatism, stereopsis, vertical imbalance, and lateral imbalance. Imagery for pitch and rhythm both auditory and visual were also measured. The group differences were very small in most of the visual tests. Furthermore, visual anomalies were not contributing to any reliable extent to music-reading disabilities. Both groups seemed to possess only a limited knowledge of musical symbolism. But in the music tests the control group registered a consistent and reliable superiority. The critical ratios that were significant were obtained in tonal memory, feeling for tonal movement, pitch discrimination and time discrimination. These aspects of musical hearing seem to be directly related to skill in music-reading.

Feeling for tonal movement is the fourth of the ten tests comprising the K-D Music Tests. It attempts to measure the ability to judge the tendency of tones to progress upward or downward. Four tones constituting an incomplete tonal pattern are played by the disc and the subject is asked to supply the fifth tone which will complete the pattern and tell whether it is up (above the last tone played) or down (below the last tone played). The fifth tone, heard cortically by the student, is never sounded by the record. It is produced subjectively by the listener and enables him to halt the tonal movement (unrest) caused by the unresolved four-tone pattern which precedes it. Whenever we have correlated scores in music-reading with scores on tonal movement, the correlations have been sufficiently marked to attract attention. In fact, none of the other tests in the battery yield so satisfactory a correlation. Obviously, the proper resolution of any melodic configuration depends upon tonal compatibility and conformity and not upon the notation which is merely the visual representation of tonal movement. It is doubtful that the good reader matches a symbol with a sound; rather, he matches a sound with a symbol. He hears first, just as the composer did. The good music-reader is much more likely to use notation to confirm what he hears.

The author has facetiously characterized the good reader as one who, failing to turn the page in time, still continues to play what appears in notation on the other side of the page before seeing what is there. Music was conceived aurally after which it was transcribed visually. Our system of teaching attempts to reverse the sequence. It is quite evident that when mistakes are made they are much more likely to be the result of errors due to unmusical hearing than errors in seeing. Good reading calls for the reproduction of sound patterns as heard originally by the composer. The ability to reconstruct the sounds that the composer heard when he put the melody together in his mind is conducive to good reading. However, errors in reading result when the subject deviates from the tonal, rhythmic, and harmonic intent of the composer.

There are patent weaknesses in this characterization but the emphasis is placed where it belongs. Congruity, compatibility, and conformity, which produce the proper tonal and rhythmic configurations, beautiful in design, must be sensed by the talented school child even though he cannot tell us how or why. Very young children can create music long before they are introduced to notation. Sensitivity to the inherent demands of the phrase to move in a given way, musical equilibrium, beauty, etc., rather than black marks on paper, condition success in music-reading. Alas, music education has been too preoccupied with ink spots and not sufficiently so with musical experience.

12

Some Generalizations

THE BASIC STRUCTURES that make musical behavior possible are inherited, for we are born with all the equipment that is ours to use. Nor can talent be acquired from the teacher, no matter how eager the student may be for musical success. The distinction made between talent and achievement must be understood. Talent cannot be accurately evaluated from achievement, nor can achievement alone be used in the prognosis of talent. But talent or no talent, the teacher's responsibility is to achieve the maximum with what the child possesses. If too much is demanded of the child he becomes discouraged, if too little he loses the incentive to achieve. By properly evaluating the native equipment of every child, the teacher may not only build the proper course of study but promote competence and skill to the maximum achievable limit.

No single consideration can compare in importance with the talent profile wisely utilized by an enlightened teacher. By wise utilization the author has in mind, among other things, the removal of barriers that retard progress, for this is one of the chief functions of teaching. To do so, the teacher must know the pupil's limitations that impede progress. The judicious use of encouragement to stimulate the child's will to achieve is another important teacher responsibility. To encourage a child, who is poorly equipped, beyond the level possible of achievement is both pedagogically dishonest and wicked. When this malefaction is committed wittingly, it is most unfortunate, for lives have been ruined by unrealizable objectives, set up arbitrarily by ambitious and unrealistic parents and teachers.

That music has a calming or exciting influence on the hearer is common everyday experience; that we enjoy the recreation that music affords is axiomatic. But do we realize that we enjoy music not so much for what it is but more for what it does? The accelerated breathing rate, the increased blood pressure, the heightened bodily tonicity, the feeling of power and the reserve of strength make us super-men as we react to music. The stimulating and energizing effects of virile martial music is well known to the soldier. Heavy packs are reduced in weight, miles are shortened, marching is easier and pleasanter, fatigue is allayed, for not only is music a tonal treat but a regenerative force, psychologically and physiologically. Blood composition, blood chemistry, blood distribution, blood pressure are all influenced by music. Equally important and extensive respiratory changes also take place under musical stimulation. Without these physiological reverberations music would be quite ineffectual, physically and mentally.

The author was first introduced to experimental esthetics by Dr. Edward Starbuck, Professor of Esthetics at Iowa, whose measurements dealing with the influence of music on the visceral organs of the body had been completed a few years earlier. It was Dr. Starbuck's belief that esthetic attitudes had a good deal more to do with stomach, lungs, heart and intestines than most people suspected. He proved his theory, too. By swallowing deflated balloons, then inflating them and adding a recording mechanism to the tubing, extending from the mouth, it was possible to obtain graphs showing the effects of music on breathing and circulation. Even the peristalsis of the stomach was sensitively recorded by the balloon. These bodily reactions, he maintained, set our behavior patterns and condition our judgments of merit. The author has never employed the balloon technique but he has conducted many experiments in the area of music appreciation in which pressure, pulse, the galvanic reflex and muscular response have been measured.

Some of the motor tests have been described but the significance of the galvanometer may not be familiar to the reader. The machine measures changes in electric potential of the body in response to music. We must add to body chemistry and body dynamics, body electricity as a concomitant of music, for voltages and resistances are changed. In time, more experimental studies will help us establish the part played by electricity which is so easily measured but not so easily interpreted. We have not overlooked the processes that have given music substance and strength for these are the primary forces in the appreciation of music. Naturally we enjoy music more for what it does to us than for what it is. This fact must be recognized by the teacher.

Every attempt should be made to discover and utilize the musical potential of the learner. While parents may encourage measurement, the responsibility for measurement falls heavily upon the teacher. Although we need more and better measuring instruments than we now have, the very same thing can be said about everything in present-day usage. To refuse to use our testing materials because they are not perfect is quite absurd. Unaided judgment may be considerably improved by the use of testing paraphernalia.

How impossible it is to judge so simple a trait as pitch discrimination without a properly constructed pitch test!

For example, it may take the voice or violin teacher months to tell that a student cannot reproduce a pitch accurately. If the difficulty is sensory, due to hearing deficiency, expecting accurate intonation is merely wishful thinking on the part of the teacher. If the difficulty is only muscular, something may be done to overcome the weakness. A sensory test which measures the capacity of the pupil to discriminate pitch differences will reveal in a matter of minutes whether the problem is sensory or motor. Since the source of the difficulty may be quickly revealed, ignorance on the part of teacher and pupil is inexcusable.

We have commented on the "mortality rate" in music study, indicating that it is greater than it should be. While it is probable that some very talented children discontinue the study of music for one reason or another, the proportion must be quite small; but not so in the case of the untalented, who see the handwriting on the wall and quit. We have no quarrel with the latter, nor do we unduly lament their leaving the ranks of music students. The author is much more concerned with our failure to discover, and, consequently, to train those who are musically gifted. This loss is irreparable and, under our wasteful system of education, never retrieved. If testing were used as a dragnet to discover and utilize talent, this indefensible loss of talent would cease. It would be well for music educators to remember the lines of Gray's "Elegy in a Country Churchyard":

> Full many a gem of purest ray serene,
>   The dark unfathomed caves of ocean bear,
> Full many a flower is born to blush unseen,
>   And waste its sweetness on the desert air.

Our school systems are so rigid and inflexible, resisting reforms. While many superintendents and principals talk about change in public, some fight it at other times and places. Conservative and cautious school administrators maintain the status quo. Let us hope that our public school systems will soon undertake the musical measurement of young children for the purpose of discovering the more talented ones who should be encouraged seriously to study music. Such a procedure would be a boon to society, with greater competence in and responsiveness to music on the part of the musician and more exalted music to be consumed.

Regardless of statistical proof, some of the ideas relating to the inverse nature of age, work, grade, and training may be strongly resisted by the reader. These values have somehow acquired a moral significance which have given them status. When a person fails to achieve with a moderate amount of effort and application we urge him to work harder, but we may discover that greater effort will not yield the desired results. The author looks upon work as a barometer of a kind, which may be very useful to all concerned. When a reasonable amount of work fails to solve the problem, talent and teaching difficulties may be indicated. When one works inordinately hard and still fails to achieve, it is irrational to suggest more work. However, when one achieves a great deal in a reasonably short period of time and with minimal effort, it is clear that he has talent and "what it takes." Hard unrewarding work, as such, must never be considered a virtue.

Unrewarding work must be thought of as compensatory behavior, employed by many musicians, young and old, unaware of the reason behind this mechanism. An individual may recognize or imagine that he is inferior and formulate a procedure to improve or compensate for his feeling of inferiority. Obviously, not every person who makes an intense effort to attain some goal displays this conflict. Clinical psychologists believe that well-adjusted individuals do not show such intense drives toward given goals, while individuals who have conflicts regarding their attainments show persistent goal-seeking activities. Often, when one believes that he does not have sufficient prestige his compensatory mechanisms become intense. Unrealizable ambitions, unsupported by talent, may lead to personality problems of a serious nature. Teachers and parents dare not drive toward an unattainable goal without considering the disruptive personality consequences.

In closing this work the author is aware of a difficulty that cannot be surmounted. We frequently repeat a well organized experiment using the same tests and techniques with new groups. The results are rarely identical nor need they exactly coincide. Nevertheless, we usually discover the same trends and tendencies which confirm earlier results. For example, it is impossible to state unequivocally just what the correlation is between music talent and intelligence, since it will never be possible to measure more than the smallest fraction of the population. What we know, therefore, is always incomplete and partial. Even with the aid of scientific instruments of measurement and mass sampling of populations, it is impossible to acquire complete knowledge. By reporting and interpreting the studies presented in this volume, the author has attempted to fill in some of the gaps in knowledge. No one is more aware of the fact that the project has been only partially accomplished and that it can never be completed.

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